CULTURAL INDUSTRIES

FOR

QUEENSLAND,

BY

L. A. BERNAYS.

T. S. Sisson

CULTURAL INDUSTRIES

FOR

QUEENSLAND.

PAPERS ON THE CULTIVATION OF USEFUL PLANTS SUITED TO THE CLIMATE OF QUEENSLAND;

THEIR VALUE AS FOOD, IN THE ARTS, AND IN MEDICINE; AND METHODS OF OBTAINING THEIR PRODUCTS.

FIRST SERIES.

BY

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"Nunquam otiosus Factis extollere famam."

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TO

SIR JOSEPH DALTON HOOKER, K.C.S.I., C.B., M.D.,

PRESIDENT OF THE ROYAL SOCIETY, D.C.L. OXON., LL.D. CANTAB.,

ETC., ETC., ETC.

Director of the Royal Gardens, Kew, England,

THIS MODEST CONTRIBUTION TO THE LITERATURE OF PLANT LIFE

IS MOST RESPECTFULLY DEDICATED,

IN TESTIMONY OF THE AUTHOR'S RECOGNITION

OF THE SERVICES RENDERED,

BY ONE OF THE MOST EMINENT MEN OF HIS DAY,

TO SCIENTIFIC AND INDUSTRIAL BOTANY.

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PREFACE.

In the early part of the year 1880, deputed jointly by the Queensland Government and by the Acclimatisation Society of Queensland, I endeavoured to learn by personal observation what progress had been made in, and what were the prospects afforded by, the cultivation of the most important and interesting among the plants which had been introduced into the colony. The observations then made abundantly proved that the mere introduction and distribution of useful plants was not sufficient to ensure their successful industrial establishment; but that they were often neglected for want of knowledge of their value, or were subjected to wrong treatment through ignorance of their habits and of the proper methods of their cultivation and utilisation.

The examples of interesting exotic plants which had been distributed by the Society, or from the Government Gardens, were numerous; but the want of a guide to their cultivation and their uses in the economy of life, rendered it improbable that they would become, as many were fitted to become, the subjects of new cultural industries.

In the report, made to the Government, of the results of my enquiry, I pointed out that a serious obstacle was presented to the development of the resources of our unrivalled climate and soil, by means of exotic plants of economic value, through want of knowledge of their habits, the method in each case of cultivation, and of the means and appliances for obtaining their products and educts. By way of remedy for this obstacle to progress I made the following suggestion:—"This might be met by the publication, under authority of the Government, of a series of papers written in a practical and popular form, containing information which is now beyond the reach of any but the very few who possess, or have access to, extensive libraries of reference on such subjects. The work would be laborious, as it would involve the comparison of many authorities, so as to sift the wheat from the chaff, and to eliminate all matter but such as is essentially practical, and would be easily intelligible. I am satisfied, however, that it would be a most useful work; and the knowledge that the Government were about to undertake it would be received with satisfaction by hundreds of cultivators of the soil who have all the will to enter upon new cultural enterprises, if they were shewn how to conduct them with reasonable prospect of success."

Finding, after the lapse of some time, that no one offered to undertake the work, I endeavoured to meet the want referred to by means of articles in one of the weekly papers; but it was found that the subject, if properly elaborated, was not suited to the available space of a newspaper, and, after the publication of a few papers, the plan was abandoned. Information promulgated in this form is, moreover, at best but of ephemeral use. After the lapse of some months, being urged thereto by some of my friends engaged in cultural enterprises, I decided to undertake the task in its present form. The Government having been pleased to accept my services, and to authorise the printing of the work at the public expense, I proceeded to rearrange and amplify the matter which had appeared in "*The Week*," so as to fit it for its new form; and to add a number of other articles.

The subjects dealt with are very far from exhausting the number of plants which might, with advantage to the individual cultivator and to the colony generally, be added to our cultural industries. A few of the plants described, while affording no prospect of creating industries, seemed to me sufficiently useful to justify their inclusion. In this series I have included no plants which have not to my personal knowledge been introduced into the colony, and been more or less largely distributed. If the Queensland planters and gardeners appreciate this effort to place reliable information before them, I am prepared to go on with the work.

Technical or scientific phrases have been made, whenever possible, to give way to common words comprehensible by all readers; and I have aimed at conciseness, wherever it could be accomplished without withholding useful information of a practical character.

Where processes of manufacture are described, I have carefully avoided confining myself to the more elaborate, complete, and costly modern appliances, intended for the larger operations of the capitalist. In a young country the endeavour to encourage a new industry must be free from anything calculated to alarm or deter,—to alarm, by leading the beginner to suppose that large means are indispensable,—to deter, by describing appliances which are beyond the power of an intelligent workman to make. I have therefore given prominence to the more crude and simple methods of converting the raw material amongst people where the distinction between large and small producers is not strongly marked. Nothing of course is easier, so soon as the pioneers of an industry can see their way with any certainty to profitable production of a new staple, than to discard the crude for the more finished and labour-saving appliances.

For what I now put before the public I do not venture to claim an equal footing with the more finished productions of Drury, Porter, Porcher, and other standard writers upon economic botany. Long observation, however, and study, together with the intimate practical experience acquired over a term of more than sixteen years of close association with the management of the Acclimatisation Society, will probably be held to entitle my writings upon industrial botany to some weight.

I have only to add that the work has been undertaken gratuitously; but I shall be more than repaid if I succeed in lightening the labours and increasing the prosperity of my fellow colonists engaged in cultural pursuits. Many years ago I publicly remarked that there was no basis of national greatness so sound, no source of national wealth so enduring, no foundation for the happiness of a people so firm, as those which spring from a wise, complete, and progressive development of the resources of nature; and that, among those resources, marvellous and limitless as they were, none had yet been discovered upon which the happiness of man so much depended as those connected with the productiveness of the soil. Twelve years of subsequent observation and experience have strongly confirmed the opinion then expressed.

In the sanction and support accorded by the Government of Queensland to my modest effort, I recognise an accord in this opinion, and an active desire to promote cultural industries as a means towards the substantial progress of this young country, to a place, in time, among the nations of the world.

L. A. B.

Brisbane,
August, 1883.

LIST OF WORKS CONSULTED.

Archer's Popular Economic Botany.
Agri-Horticultural Society of Madras, Proceedings of.
Agricultural and Horticultural Society of India, Journals of.
Accum on Culinary Poisons.
Acclimatisation Society of New South Wales, Reports of the.
Acclimatisation Society of Queensland, Proceedings of the.
Balfour's Botany.
Balfour's Cyclopædia of India.
Baker's Nile Tributaries.
Bennett's Gatherings of a Naturalist.
Cleghorn's Forests and Gardens of Southern India.
Chinese Materia Medica, by F. P. Smith, M.B., Medical Missionary to China.
Cooke's Microscopic Fungi.
Ceylon Tropical Agriculturist.
Crawfurd's Indian Archipelago.
Drury's Useful Plants of India.
Don's General System of Gardening and Botany.
Ellis on the Mangosteen and Breadfruit.
Elliott's Experiences of a Planter in the Jungles of Mysore.
Edwards' History of the British West Indies.
Firminger's Manual of Gardening for Bengal and Upper India.
Figuier's Vegetable World.
Fortune's Wanderings in China.
,, Tea Countries of China.
Flora Vitiensis—Seeman.
Flora of the West Indian Islands—Griesebach.
Flora Capensis—Harvey and Sonder.
Flora Hongkongensis—Bentham.
Flora of Mauritius and Seychelles—Baker.
Flora, Forest, of British Burmah—Kurz.
Flora of British India—Hooker.
Flora of the Niger—Hooker.
Flora, Forest, of North-west and Central India—Brandis.
Flora Indica—Roxburgh.
Flora Sylvatica—Beddome.
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Hogg's Vegetable Kingdom.
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Liberian Coffee, Notes by D. Morris, M.A., Director Botanical Gardens of Jamaica.
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Medical Botany.
Mueller's Select Extra-Tropical Plants.
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Meyen's Botanical Geography.
O'Connor, J. E. (Calcutta), on the Vanilla.
Porcher's Resources of the Fields and Forests of the Southern States of America.
Porter's Tropical Agriculturist.
Pereira's Materia Medica.
Rhind's Vegetable Kingdom.
Revista de Horticultura (Rio de Janiero).
Reports of the Department of Agriculture, United States.
Royle's Fibrous Plants of India.
Royle on the Productive Resources of India.
Robertson's Report on the Agricultural conditions of the Neilgherry District.
Robinson's Parks, Promenades, and Gardens of Paris.
Smith's Domestic Botany.
Simmond's Tropical Agriculture.
Seeman's Popular History of Palms.
Squier's Tropical Fibres.
Schomburghk, Dr. R., Director of the Botanic Gardens, Adelaide, S.A., Reports and Essays.
Von Tschudi's Travels in Peru.
Wittstein's Organic Constituents of Plants, Translation by Baron Sir F. von Mueller.
Waterston's Encyclopædia of Commerce.
Yeats' Natural History of the Raw Materials of Commerce.

CULTURAL INDUSTRIES FOR QUEENSLAND.

ALLIGATOR, or AVOCADO, PEAR.

(*Persea gratissima.*—LAURACEÆ.)

This tree, originally a native of the West Indies, is now common to most tropical countries, in some of which it has become subspontaneous. It attains to the size of the common Apple-tree; the leaves are large, oblong, and smooth, of a refreshingly bright-green colour. The flowers, which are yellowish-green in colour, are produced towards the extremity of the branches.

The fruit is of the size of a large pear, which it much resembles, with a tough coat, and containing a large rugged seed within one or two membranous covers. The fleshy part of the fruit is of a bright-yellow colour, with a rich, delicate, creamy texture of about the consistency of firm butter, and with the fine flavor of a fresh walnut.

Its mild flavour and delicately soft texture, which make it so agreeable to the palate, have earned for the Avocado Pear the vernacular name of "subaltern's butter," and it is also sometimes called "vegetable marrow." The richness of the pulp, so described as butter or marrow, necessitates to most people the addition, when eating it, of something pungent, such as wine, or limejuice and sugar, or pepper and salt—the two latter being the favourite condiments.

A fixed oil is supposed to constitute the principal part of the fruit; which, although when ripe both delicious and wholesome, is stated by Paxton to be dangerous if eaten in an immature state, when it has been known to produce fever and dysentery. The fruit is eaten with avidity by men, birds, and quadrupeds alike, and as the agreeable qualities only develop themselves when it is perfectly ripe, its unwholesomeness at an earlier stage is of no moment.

One authority states that there are three varieties—red, purple, and green—but this I have not been able to verify.

The Avocado Pear is usually propagated from seed, but may be struck from cuttings made of half-ripened wood without mutilating the leaves. The tree grows well, and fruits freely on our coast lands.

One specimen in the Brisbane Botanic Gardens has fruited regularly for some years; and another at Bowen Park is expected to come into bearing next season.

ALLSPICE, PIMENTO, or JAMAICA PEPPER.

(*Myrtus Pimenta—Eugenia Pimenta—Pimenta vulgaris.*—MYRTACEÆ.)

A native of South America and of the West Indies, especially of Jamaica, whence the principal supplies of allspice are derived. The *Eugenia Pimenta* is an exceedingly handsome tree, attaining under suitable conditions of climate a height of at least thirty feet. It has a smooth trunk with shiny

green leaves something like those of the "Bay." The foliage is very luxuriant, and as the tree branches equally all round the effect is very handsome, especially in the contrast presented between its profusion of small white flowers and rich green leaves. It affects hilly situations, and will grow on barren land unfit for any other cultivation. Porter instances a fine specimen standing on the ridge of a rock about twenty feet in circumference, and eight feet from the surface of the ground, the roots encompassing the whole surface of the rock, and finding their way down to the soil whence the tree derived its nourishment.

The Pimento is said to be very impatient of all attempts at entirely artificial cultivation where the tree does not grow spontaneously, very few of the efforts made to propagate young plants, and grow them into trees by the ordinary methods of cultivation, having been successful. Experience of the tree in Queensland is very limited; the only specimen known to the writer being one on a hill-side in the Brisbane Botanic Gardens. This tree is some fifteen years old, and about twenty feet high. I cannot learn how long it has been bearing; but last season it yielded a small crop of sound healthy berries—a fact sufficiently encouraging to induce attempts at cultivating so useful a tree. The following is the principal method of cultivating the Pimento-tree in Jamaica:—A selection is made of land where the natural vegetation is interspersed with these trees, or in the immediate vicinity of an old plantation. The whole of the other timber and undergrowth is cut down and left to decay, the Pimento-trees alone being allowed to remain intact; among the ruins of the other timber, the young Pimento plants spring up in profusion where the seed has either fallen or been deposited by birds; the prostrate branches of the felled trees affording a valuable protection to the tender plants. In due course these are thinned out; and, when in two years' time the dead timber and rubbish is cleared away, the young trees are free to grow to maturity, and the plantation, thus curiously created, is thenceforth tended in the usual way, the trees arriving at maturity in about seven years.

The Pimento flowers twice, but only bears a regular crop once a year. The fruit is a small berry, somewhat larger than a peppercorn, and containing two seeds, and when ripe is succulent and of a black or dark-purple colour. The produce is variable in quantity, but a good tree, under favourable conditions of season, will give a hundredweight of the dried spice; the loss in drying being about one-third of the weight of the freshly gathered berries.

If the berries are left to ripen they become moist and glutinous, difficult to cure, and not only lose their pungency and delicate aroma, but acquire a different flavour somewhat resembling juniper berries. The fruit is, therefore, gathered while still green, and is either sun-dried on mats or terraced floors, or cured by a more rapid process in kilns. Curing in the sun takes, under favourable circumstances, about seven or eight days. During the process the heaps are frequently turned and winnowed; great care being taken to preserve them from either rain or dew. Drying constitutes the sole process of preparation for market; and when this has been properly done, the article is ready for packing and export. It will happen that some of the ripe berries get mixed with the unripe, but this is avoided as much as possible; and for the reason that, in exact proportion as this occurs, the value of the commodity is injured, the berries are gathered nearly as soon as they are formed, and before they have begun to mature. When sufficiently cured they present a rough exterior and a dark-brown colour, and the seeds rattle inside.

The common name "Allspice" is derived from the idea that Pimento combines the flavour of cloves, cinnamon, nutmeg, and pepper.

The aromatic properties of the fruit are contained in a volatile oil, the dissipation of which, as the fruit matures, accounts for the necessity for securing the crop while still green. The aromatic and pungent qualities reside principally in the external skin of the berry; but the same properties, in less degree, are found in every part of the plant. Alcohol extracts the entire virtues of the berry; but the aroma, and some part of the astringent and pungent principles, are extracted by water. The chief use of allspice is in cookery. In medicine, however, it is found in various forms of heavy and light "oil of pimento," in "spirit of pimento," and "pimento water." Its medicinal properties are very similar to those of cloves, being a warm aromatic stimulant and carminative, relieving flatulency, stimulating and giving tone to the stomach, and promoting digestion. It is also used, in common with some other of the spices, as a cover for medicines of unpleasant flavour, and to prevent the griping of purgatives.

The oil, obtained by distillation with water, when coloured with Alkanet root (*Anchusa tinctoria*) is commonly sold as oil of cloves, although by no means possessing the full properties of the latter.

Simmonds states that Pimento is also used in tanning, and that a patent has been taken out in Jamaica for employing the leaves as a tanning material; but this is not supported, and, if true, possesses little interest in Queensland, where superior tannin-producing material is so abundant. One other use of the tree remains to be enumerated—namely, that of being convertible into good walking-sticks and umbrella-handles.

According to the *Scientific American*, the umbrella trade threatens the existence of the Pimento plantations of Jamaica. It was shown by an official estimate made at Kingston, last autumn, that more than half-a-million of umbrella-sticks were then awaiting export to England and the United States. These sticks were almost without exception Pimento, and it is not surprising that owners and lessees of Pimento walks are becoming alarmed at the growth of a trade which threatens to uproot in a few years all the young trees. The export returns for the last five years show an average of 2,000 bundles of sticks sent out from Jamaica annually; and the returns for the first three quarters of 1881 show an export of over 4,500 bundles, valued at 15,000 dollars. Each bundle contains from 500 to 800 sticks, each of which represents a young, bearing Pimento-tree.

But, apart altogether from its commercial value, the Pimento-tree is a very desirable addition to our gardens. Even as a shrub it is beautiful for its ornamental, bright foliage; and when planted in a clump, the slightest breeze will fill the air with a delicious perfume exhaled from the leaves. These latter when bruised yield an aromatic odour nearly as strong as that of the fruit; and, judiciously used by the cook, and in connection with the domestic medicine chest, may serve many of the purposes of the spice, and render the possessor of a tree, so far as his household is concerned, independent of its fruiting.

Edwards, in his history of the British West Indies, says:—"I do not believe there is in all the vegetable creation a tree of greater beauty than a young Pimento. The trees form the most delicious groves that can possibly be imagined, filling the air with fragrance, and giving reality, though in a very distant part of the globe, to our great poet's description of those balmy gales which convey to the delighted voyager—

> "Sabean odours from the spicy shore
> Of Araby the blest—
> Cheered with the grateful smell, old Ocean miles."

The seeds of the Pimento-tree are very perishable, and have proved difficult to import; and the number of plants brought to Queensland has been hitherto small. As, however, the seeds borne by the specimen in the Brisbane Botanic Gardens germinate freely, plants will be available henceforth without the risk and trouble of importation.

AMLA.

(*Phyllanthus Emblica—Emblica officinalis.*—EUPHORBIACEÆ.)

A small tree found in dry situations all over India, in Burmah, Ceylon, and the Indian Archipelago, at various levels up to as high as 4,000 feet. The name *Phyllanthus* is a compound of two Greek words indicating the growth of the flower at the foot of the leaf.

The foliage is singularly pretty, being of a bright green, shading off towards the terminal points of the branches to a golden brown; a singularity which, combined with a graceful arrangement of the leaves, produces a charming effect.

The small round fruits are plentifully produced, and are used for pickling and preserving, but are too sour to eat raw. In the Punjab they are made the basis of ink and of a black dye.

The timber is very valuable, being hard, fibrous, flexible, and straight-grained. It is durable, indeed remarkably so, under water; and for this reason is much used in India in the construction of wells. For building purposes and furniture, as well as for such uses as gunstocks and turning, it is in great demand.

The bark is in requisition for tanning, and is used medicinally for diarrhœa. The young leaves, infused in sour milk, are given by the natives in dysentery cases. Infusions of the leaves are also applied with effect to sore eyes; and the root-bark is similarly applied for inflammation of the mouth. Both seeds and leaves are used medicinally by the natives in diabetes, fevers, and bilious affections. The flowers are also credited by the native doctors with refrigerant and aperient properties.

The young branches and chips of the wood thrown into impure or muddy water are said to clear it effectually.

From the root an astringent extract, equal to catechu, has been prepared, both for medicine and the arts.

The tree has been largely distributed in Queensland and has probably found a home in many of the gardens north of Brisbane. A specimen may be seen at Bowen Park.

AMATUNGULA, or NATAL, PLUM.

(*Carissa grandiflora.*—APOCYNACEÆ.)

A native of South Africa; a large shrub with strong thorns in couples at every leaf-bud. The foliage is rich and glossy, and the flower white, with a strong perfume similar to that of the orange, which, as an ornamental tree for garden purposes, it much resembles. In the wild state it is found chiefly about Natal and district, growing near the sea, the salt water often washing up to its roots. Here and there a stunted specimen may be found on the high land in the dense bush which skirts the coast, after which it disappears altogether. Although like most plants it responds by vigour of growth to

generous treatment, poverty of soil at least, if not restricted rootrun, seems necessary to make it flower and fruit. The close habit of growth of the plant, and its formidable thorns, would probably make it useful for hedges. It is very hardy under the pruning shears.

The fruit is well worth growing, as, when quite ripe, it is decidedly pleasant in a raw state, and makes an excellent preserve. When ripe, it is a light but bright-red colour, of an olive shape, varying in size from a large olive to a pullet's egg, although I have not seen it attain the latter size in Queensland. The flavour is sweet and slightly astringent; the appearance of the fruit when broken in two being oddly similar to that of strawberries and cream. In eating it should be put well into the mouth, as the creamy appearance is due to an exudation which, when in contact with the lips, is somewhat sticky. It has the high quality, however, of being remarkably wholesome; and in Natal it enters largely into consumption in the form of jam.

The plant is readily propagated from seed, layers, or cuttings, and is well adapted for profitably occupying much of the poor land near high-water mark, which is comparatively worthless for any other purpose. I cannot say if, like the cocoanut, it will thrive in pure sand, but the experiment is worth trying.

ARGAN TREE.

(*Argania sideroxylon—Sideroxylon spinosum.*—SAPOTACEÆ.)

This is a low, spreading, evergreen tree of a shrubby nature, with very small leaves and covered with short spines. The branches start a few feet from the ground, inclining downwards until they reach the earth at a considerable distance from the stem, when they ascend again. The roots also extend a great distance underground and send up suckers at intervals. The branches of the tree closely interlace in every direction, and from its bushy, thorny character it would appear well calculated, if properly trimmed, for hedges which would be utterly impervious to sheep or pigs. To show the character of the growth of the Argan, a tree is mentioned measuring only 16 feet in height, while the circumference of the branches was 220 feet. It thrives in poor light stony and arid soil, and is eminently adapted for cultivation in warm countries subject to drought.

The Argan is a native of Morocco, being common in the States of Western Barbary, in certain provinces of which it grows in woods. The fruit is like a small plum, egg-shaped or roundish, and is greatly relished by all ruminant animals, who in chewing the cud reject the hard seeds, which are afterwards collected for the extraction of their oil. Large quantities of the fruit are collected and fed to cattle under conditions where the rejected nuts can be easily collected. As the crop ripens also, herds of camels, goats, sheep, and cattle are taken out among the trees, which are beaten with a long pole; the fruit, as it falls, being devoured voraciously. In the evening the flocks and herds thus fed are driven home, and when comfortably settled in their yards they commence chewing the cud, throwing out the nuts; and these are collected each morning as soon as the animals have departed on their daily excursion. The nuts sometimes pass through the stomach, but this is only a casualty. It is a curious circumstance that, while the fruit of the Argan is greedily devoured by the above-named animals, the horse, the ass, and the mule do not like it. Large quantities of the fruit are also collected by women and children, and well dried. The hull is then removed and stored

as fodder for the camels and mules travelling in winter, and is considered very nutritious. The mode of extracting the oil is primitive. The nuts, which are very hard, are cracked by women and children, and after being roasted to a brown colour the kernels are ground in a rude handmill. The resulting matter is then put into a pan with a little hot water, and is kept constantly stirred and kneaded with the hand. The cake—in which, when the method of pressing is defective, a good deal of oil remains—is generally given to the milch cows and goats. During the operation the oil runs out at the sides, and is from time to time poured into a clean vessel. The process of kneading is carried on until the mass becomes so hard that it can no longer be kneaded; the harder and firmer the coarse residuary parts, the more completely is the oil extracted. At the last, cold water is sprinkled on it in order, as they say, to expel the last particles of oil. The main point to be attended to in order to extract the greatest quantity and the best quality of oil, is that it should be well kneaded, and that the proper proportion of hot water for the extraction of the oil should be used. The residuary mass, often as hard as a stone, is of a black-brown colour, and has a bitter disagreeable flavour. The oil itself, when it has settled, is clear, of a light-brown colour, and has a rancid smell and flavour. It is capable of purification, but when used without preparation in cooking it has a stimulating and pungent taste. The vapour which arises when anything is fried in it affects the lungs and occasions coughing. The common people use it generally without preparation; but in better houses it is the custom, in order to remove the pungency, to mix the oil previously with water, or to put a bit of bread in it and let it simmer before the fire. The empty husk of the nut is used as fuel, and the best charcoal is made from the timber of the tree, which is hard, tough, fine-grained, and of a yellow colour.

The foregoing account is chiefly derived from a report made to the Secretary of State for the Colonies by the British Consul at Mogador, some twelve years ago, and reached the writer through the Acclimatisation Society of New South Wales, which was then in existence. Accompanying the report was a package of the nuts, from which hundreds of plants were raised and distributed throughout the warmer parts of the colony. A good specimen may be seen at Bowen Park, strongly exemplifying some of the characteristics of the tree.

The Argan is propagated either from seeds or cuttings. The wood is very hard, and so heavy as to sink in water.

ARNATTO.

(*Bixa orellana.*—FLACOURTIACEÆ.)

A large shrub indigenous to tropical America. It is cultivated in the East and West Indies, Mauritius, Java, and elsewhere for its well-known dye, which is called in the trade by the above spelling of its name, as well as by those of Annatto, Arnotta, Arnotto, and Annotta. It is the product of a large and handsome shrub, which, for the beauty of its foliage and flowers alone, should be found in all large gardens. There are two species, one with rose and the other with white flowers. The former is a charming shrub, its delicate pink flowers, which open much like a single rose, contrasting with great effect with the large pale-green waxen-looking leaves; and the plant is no less handsome when the flowers are followed by the oblong prickly pods, not unlike, except in form, those of the chestnut. These are at first a rose

colour, changing to a rich brown, and when ripe opening to display the seeds, which, about the size of raisin-stones, are covered with a bright vermillion-coloured waxen pulp. It is this pulp from which is made the arnatto of commerce.

The seeds are reputed to be cordial, astringent, and febrifugal, and the pulp astringent and slightly purgative; and they are used as an antidote for the poison of the *Jatropha manihot*, from which Cassava is prepared.

The bark produces a strong fibre from which in the West Indies they make cordage. The wood, though small, is used, the sapwood being red and the heartwood paler and close-grained.

The colouring matter is put to many uses, from its well-known application as a colouring for cheese and butter, and as an ingredient in chocolate, to various purposes in the arts of dyeing, varnish-making, and lacquering. Mixed with lemon-juice and gum it forms the vermillion colouring matter with which the North American Indians paint themselves.

Arnatto is made by various processes, all more or less simple, and requiring no machinery whatever. The quality of the article produced varies, however, very much, as it is often injured in the preparation. Some, after bruising the pods, boil them and remove the colouring matter in the form of scum; but the product of this process is by no means superior. Indeed the best authorities recommend the avoidance of heat. The best methods are in fact the simplest. The pulp with the seeds is removed from the pods and soaked in warm or cold water, the mass being kept frequently stirred, and the pulp being bruised off the seeds. After straining off the seeds, the remaining solid matter is allowed to subside, some leaving it long enough to ferment, and others pouring off the water at once. The precipitate, when dried in the shade, constitutes the staple product. While in the putty state, it is made into cakes of 2 or 3 lbs. weight, and wrapped in leaves. In this form it is known as "flag arnatto"; but it comes also in the form of "roll" or "cake" arnatto, which is more thoroughly dried, and is held in better repute. These rolls, which are the commonest form in the English market, are brown outside and red inside; but the colour varies from bright yellow to red, according to the process used.

It is stated that the Indians prepare an arnatto greatly superior to that which comes to the English market, of a bright shiny red colour, almost equal to carmine. To obtain this, instead of steeping and fermenting the seeds in water, they rub them with the hands, previously dipped in oil, till the pulp comes off in the form of a clear paste, which is scraped off from the hands, and dried on a clean leaf in the shade.

The colour of arnatto as a dye is unfortunately fugitive, and it is therefore not much used, except for cheap fabrics, in which permanency of colour is not important. As a colouring ingredient for cheese, 8 dwts. of arnatto are used to 60 lbs. of cheese in Wiltshire; and in Gloucestershire 1 oz. to the cwt.

The market value of arnatto in London is about one shilling a pound.

Arnatto is not free from fraudulent adulteration. Of the foreign substances known to have been used, the most objectionable are vermillion and red lead. Contamination with the latter has led to the rendering poisonous whole batches of cheese. As an instance of how difficult it is to secure immunity from adulteration and its effects, the following case is not without interest:—A gentleman, temporarily resident in a city of the West of England, was seized at his hotel with distressing symptoms which led him to apprehend some internal inflammatory disorder. In a few hours the symptoms subsided, under treatment, but were repeated on four successive days until they were directly traced to the eating of a Gloucester cheese; a servant in the household having

in the meantime had a similar seizure. Analysis showing the presence of red lead, considerable trouble was taken to trace the cheese back to the maker, when it was found that, the supply of arnatto having run short in the factory, recourse had been had to the use of vermillion as a colouring matter. This, however, not accounting for the lead poisoning, the inquiry was continued, until the druggist from whom the so-called vermillion was purchased admitted its having been mixed with a portion of red lead, and pleaded that he could have had no reason to expect that the article would be used otherwise than as a pigment, for which purpose the admixture was innocuous.

Adulteration of the colouring matter of cheese with lead may be detected by macerating a portion of the suspected cheese in water impregnated with sulphuretted hydrogen, acidulated with muriatic acid, which will instantly cause the cheese to assume a brown or black colour if the minutest portion of lead be present.

The plant is easily propagated from seed, and for garden purposes is content with a poor soil. The pods ripen late in the autumn.

BAEL-FRUIT, or BENGAL QUINCE.

(*Œgle marmelos.*—AURANTIACEÆ.)

This is a medium-sized, erect tree, deciduous, with few and irregular branches and ash-coloured bark. It is armed with straight, strong, and sharp spurs, an inch or more in length, at the axis of the leaves; and the flowers are white and clustering. The fruit is either globular, oblong, or pear-shaped, from 2 to 5 inches through, with a smooth, hard shell, requiring considerable force to crack, and yellowish-grey in colour. The seeds are imbedded in a strongly mucilaginous, transparent pulp, orange-coloured, sweet, and aromatic. The scent of the ripe interior is very fragrant, and the flavour is very agreeable to those who are accustomed to it. When fresh, the pulp may be drawn out into threads two yards long, and so fine as to be scarcely perceptible to the naked eye, before breaking.

The Bael-tree is wild in many parts of India, chiefly in dry, hilly places, ascending to a height of 4,000 feet, but is also commonly cultivated throughout that country and in Burmah; and apart from the esteem in which the fruit is held for its medicinal qualities, it is much eaten by those who once acquire a taste for it. Of the ripe fruit, one of the best authorities speaks in the following terms:—"It is nutritious, warm, and cathartic; in taste delicious; in fragrance exquisite; its aperient and detersive qualities, and its efficacy in removing habitual costiveness, have been proved by constant experience." It is, however, in the unripe or half-ripe fruit that the medicinal properties of the plant are most manifest. In dysentery and all affections of the bowels accompanied by relaxation, it is a valuable remedy; relieving dysentery and diarrhœa without constipating. The unripe fruit is cut into slices and dried, and in this state it is used in the proportion of two ounces to a pint of water, the mixture being gently simmered down to one-fourth. The dose naturally depends upon the condition of the case; three tablespoonfuls being given from every two to every six hours. The medicinal properties of the tree are not, however, confined to the fruit. The bark of both root and stem are made into a decoction for administration in cases of bilious fever, palpitation, &c.; and the expressed juice of the leaves, diluted with water, is given in colds and incipient fevers. The juice is slightly pungent and bitter, and induces perspiration. The young leaves also are used in ophthalmia, by being made warm and applied to the eyes. A sort of

sherbet is also prepared from the fruit, in combination with that of the tamarind, being very beneficial in allaying thirst in fevers. A jelly and preserve are made of the ripe fruit, which, besides being very palatable, are used beneficially by persons suffering from habitual costiveness.

I have dwelt upon the medicinal properties of the plant because there is very high authority for them, and because, containing no poisonous element, they can be put to use without fear by all who are able to grow the tree. The glutinous mucus is used by painters as a size and varnish, and it is put to the further strange use of mixing with the mortar used in the construction of wells.

The tree, being so much esteemed for its fruit, does not appear to be often felled; but the timber is much valued, being close-grained, hard, and tough, and takes a fine polish. It is used for making the pestles of oil and sugar mills, the naves and other parts of carts, and for agricultural implements. An excellent perfume is distilled from the flowers, and a yellow dye is obtained from the rind of the fruit.

The tree may be propagated from layers or seed. A specimen at Bowen Park has flowered abundantly, but has not yet fruited; but I have seen good fruiting specimens at Bowen and elsewhere on the coast.

It may be useful to refer to the fact that the interior of the fruit can be dried into a hard transparent substance, which keeps well without injury to its properties.

BANANA AND PLANTAIN.

(*Musa Paradisaica and M. sapientum.*—MUSACEÆ.)

These two, while having distinct specific names, are by the best authorities regarded as only varieties of the same species. The distinction between them is stated to be that the former have a stem wholly green with persistent male flowers, while the latter have deciduous male flowers, a spotted stem, and shorter and rounder fruit. There are many kinds of *Musa*, no inconsiderable number being grown in Queensland; but the distinction between variety and species has never been accurately determined in this genus. Kurtz, an eminent Indian botanical authority, describes the literature of the Banana as being chaotic, and was engaged in the endeavour to disentangle and arrange the information upon the subject when death unfortunately brought his labours to a sudden close. In his early papers upon the genus he makes no fewer than a hundred varieties. There is a good deal of confusion of ideas as to the true distinction between the Plantain and the Banana; and this is increased by the fact that in some English-speaking countries where the fruit is largely cultivated the term "Plantain" is the common designation, while in others that of "Banana" is as commonly used. Perhaps the best distinction is the application of the term "Plantain" to those varieties which are only used for cooking, or are otherwise prepared; and that of "Banana" to those which make a pleasant fruit when eaten ripe. *Musa* is the generic name of all, and the term "Plantain" may practically be discarded as having no scientific meaning; while in the vernacular there is no common agreement as to what species shall be called by one name and what by the other.

The *Musas* are natives of Africa, the Islands of the South Pacific, of tropical plains, and of Japan; and several species are found in Queensland, on the hot coast lands of the North. Amongst others is the grand *Musa uranoscopus*, which produces its fruit on an upright stem, and which the Acclimatisation Society of Queensland has been instrumental in adding to

the *flora* or introducing to the conservatories of half the civilised world. Of this species the following legend is current in Fiji, where it is also found :— The erect fruit stem is accounted for by the belief that once upon a time the Bananas and the Plantains had a great fight, in which the species referred to—probably from its superior size and strength—came off victorious, and ever after proudly held its head erect; the vanquished being so humiliated as never to have held up their heads again.

For grandness of proportion and gracefulness of habit the *Musas* are only second to the Palms, which are justly called the Royal Family of the Vegetable Kingdom. The Banana can only be seen to perfection in and near the tropics. After living for many years in the Brisbane district, I confess that I had no idea of the magnificence which these plants can attain until seeing them growing on the banks of the rivers of Northern Queensland. The noblest proportions are attained by species of which the fruit is all but worthless. Among these may be mentioned *Musa superba*, a species introduced from India and largely distributed on the Queensland coast. Under a single leaf of this species I have been successfully sheltered during a heavy thunder-shower. *Musa ensete*, an Abyssinian species, also introduced and growing, but not as yet largely distributed, at 6 inches above the soil attains a girth of from 7 to 8 feet, with leaves 17 feet long and more than 3 feet wide, asserted to be the largest entire leaf known to the Vegetable Kingdom. Amongst the most curious is the "Wax Banana" of Java, which grows by millions, according to Kurz, in the light jungles on the slopes and in the valleys at elevations varying from 300 to 1,500 feet. The under surface of its leaves (6 feet long by 2 broad) is covered with a white meal-like rime, which the Javanese scrape off with wooden knives after they have cut down the whole plant, which bears usually about seven leaves. The lower portion of the concave petioles (the sheath), which embrace one another and form the stem of the plant, serves as a vessel wherein the waxy meal is collected. Having filled this sappy gutter, they put it in a somewhat sloping position over a fire, and thus melt the wax, which now flows off into a pot or the half of a cocoa-nut placed at the lower end of it. The stream of wax is usually conducted through a bundle of areng fibres, fastened at the lower mouth of the gutter with a view of clearing the fluid of impurities.

The extent to which the Banana is cultivated, and the number of human beings who are more or less dependent upon it for food, in warm countries, is wonderful; equalling and perhaps exceeding that of any other known plant. It is one of the most useful plants of the world, and seems to have migrated with man wherever it would grow. It is for an immense portion of mankind what wheat and other cereals are for the inhabitants of Europe and Western Asia. The spread of the Banana, from the facility with which it grows and produces its fruit, is thought to have contributed to laziness of habit among the partially civilised races in the countries where it thrives; so much of their food growing almost without labour. It is one of the greatest blessings bestowed on mankind in hot climates. In India there is hardly a cottage which has not its grove of Bananas; and as it is cultivated not only on the plains, but in the Himalayas to an elevation of 5,000 feet, in the Neilgherries of 7,000 feet, and on the Sutlej of 4,000 feet, the area of its cultivation in India alone is enormous. The great missionary, John Williams, the "Martyr of Eromanga," introduced the Cavendish Banana, a Chinese species, from the Duke of Devonshire's conservatories at Chatsworth into Fiji, whence again it was carried by the Rev. G. Pritchard to the Tongan group, and its introduction has put an effectual stop to the famines which previously were sometimes experienced in those islands. Its low habit of growth in that part of the world where hurricanes periodically occur gives

it a great advantage over the taller species, which are at such times levelled with the earth by the resistless fury of the winds; and for this reason, as well as for the richness of its fruit, it is the most commonly grown. "But for Plantains," says Dr. Wright, "Jamaica would scarcely be habitable, as no species of provision would supply their place. Even flour, or bread itself, would be less agreeable and less able to support the laborious negro, so as to enable him to do his work and keep his health."

As an article of food the Banana is perfectly wholesome and digestible, and is very satisfying. Its nutritive qualities depend largely upon the stage of growth. The unripe fruit abounds in starch; but in the process of ripening this disappears, being converted into a mucilaginous substance, and this into sugar, until in the ripe fruit not an atom of starch is left. When gathered immature, therefore, the fruit, on account of the presence of the starch, is more nourishing than when perfectly ripe. In Queensland we hardly appear to understand the Banana in any other form than that of the ripe fruit as a dessert; but later on in this paper I shall be able to indicate a variety of methods of preparation, which, as they involve the use of the fruit in an unripe state, are for food purposes far more valuable than the fruit in the last soft and luscious condition immediately preceding decay. Professor Johnston says the fruit of the Plantain approaches most nearly in composition and nutritive value to the Potato, and Plantain Meal to those of Rice. Thus the fruit of the Plantain gives 37 per cent. and the raw Potato 25 per cent. of dry matter. In regard to its value as a food in northern climates, there is no reason to doubt its fitness to sustain life; and in warmer and tropical climates it becomes still more so. Boussingault considers the nutritive value of the Banana to be superior to that of the Potato, and states that he has given as rations to men employed at hard labour six and a-half pounds of unripe Bananas and two ounces of salt meat. The meal, prepared —as hereafter described—from the unripe fruit, has given by analysis no less a proportion than 68 per cent. of starch, a fact speaking volumes for its food value, while that it is easy of digestion is shown by its common use in the West Indies as food for infants, children, and invalids.

Methods of Preserving and Cooking.—There are various ways in which —some of them among civilised and others among semi-barbarous people— the unripe Banana is put to a profitable use. Taking the case of an all but savage race, we find Baker, in his "Albert Nyanza," thus speaking on the subject:—

"Curious as it may appear, although we were in the land of Plantains, the ripe fruit was in the greatest scarcity. The natives invariably eat them unripe, the green fruit when boiled being a fair substitute for potatoes—the ripe plantains were used for brewing Plaintain cider, but they were never eaten. The method of cider-making was simple. The fruit was buried in a deep hole and covered with straw and earth; at the expiration of about eight days the green Plantains thus interred had become ripe; they were then peeled and pulped within a large wooden trough resembling a canoe; this was filled with water, and the pulp being well mashed and stirred, it was left to ferment for two days, after which time it was fit to drink.

"Throughout the country of Unyoro, Plantains in various forms were the staple article of food upon which the inhabitants placed more dependence than upon all other crops. The green Plantains were not only used as potatoes, but when peeled were cut in thin slices and dried in the sun until crisp; in this state they were stored in the granaries, and when required for use they were boiled into a pulp and made into a most palatable soup or stew. Flour of Plantains was remarkably good; this was made by grinding the fruit when dried as described; it was then, as usual with all other articles

in that country, most beautifully packed in long narrow parcels, either formed of plantain bark or of the white interior of rushes worked into mats. This bark served as brown paper, but had the advantage of being water-proof. The fibre of the plantain formed both thread and cord, thus the principal requirements of the natives were supplied by this most useful tree. The natives were exceedingly clever in working braid from the Plantain fibre, which was of so fine a texture that it had the appearance of a hair chain, nor could the difference be detected without a close examination. Small bags netted with the same twine were most delicate, and in all that was produced in Unyoro there was a remarkably good taste displayed in the manufacture."

Going to Fiji, we find the Banana variously prepared. Split in half and sandwiched with grated cocoa-nut or sugar-cane they are served with cocoa-nut milk, and thus make a favourite pudding used as well by the white settlers as by the natives. They are also beaten into a pulp and diluted with cocoa-nut milk or water. In this way they are prepared in large quantities in a kind of cistern with a framework of wood lined with the leaves of the trees, one being a sufficient load for six or eight men. As many as eight of such vessels full are sometimes consumed at one feast. Substituting milk and sugar for the cocoa-nut milk or water of the Fijian receipt, we have a deliciously cool and wholesome summer dish suited to all ages. Dried Bananas from Fiji have become an article of regular import to the Sydney markets.

In India they are used in a variety of ways. The young shoots form a delicate vegetable. For use as bread they are roasted or boiled when just fully grown, and before beginning to ripen. In the ripe state the fruit is sliced and fried in butter, or dried and preserved, in which latter form they taste like figs. Dried Plantains form an article of commerce at Bombay and other parts of the Peninsula. They are merely cut in slices and dried in the sun, and being full of saccharine matter make a good preserve for the table. In this form they also come from the South Sea Islands; and I have often bought them, derived from this source, in small bundles of about a dozen each wrapped in their own leaves.

The method of drying the ripe fruit depends much upon the degree of dryness of the climate. In parts of Mexico where the climate is very dry, the ripe fruits are exposed to the sun till the skin begins to wrinkle. They are then peeled, and again exposed until an efflorescence of sugar appears on the surface, as in dried figs. They are then pressed in masses of about 25 lbs. each. This process is, however, practicable only in a very dry climate; and where that condition does not exist other methods are resorted to. Of these, Simmonds gives three, viz.:—(1.) Exposing the ripe fruit to an atmosphere of sulphuric acid gas before attempting to dry; (2.) By boiling rapidly in water to which sulphate of lime has been added; and (3.) By boiling in syrup. By either of these processes the albumen and caseine of the fruit coagulates, and the well-known tendency of the Banana to decay and ferment is arrested. The second method is said to be the best, and has the advantage of simplicity. To expose the fruit after boiling to the sun's rays, trays of bamboo, or anything which is clean and permits the free action of air and light, are used. If rain falls, they are dried in an open oven in a moderate heat, where the air can circulate. The preparation is seen to be very simple; and with the abundance in which the fruit is produced, a profitable industry in dried Bananas is open to Queensland growers. The dried fruit has been known to keep good for 16 years.

More than 50 years ago the Society of Arts in London recognised the importance of making dried Bananas a staple commodity, by offering a premium for a certain given quality and quantity. Some of the exhibits which were two years old are described as "sufficiently moist, of a consistence and flavour between the date and the fig, and very sweet without acidity." As a branch of domestic industry, the drying of the Banana affords promise of important results to the prosperity of our coast farmers.

But the methods of utilising this invaluable vegetable product are by no means exhausted by those before described. Stewed with sugar and orange juice they make a delicious dish; and in some parts of the world, made into a paste with sugar and spices they are carried by travellers as a compact and useful article of food. The negroes of the West Indies rub the ripe Banana through a sieve—form the pulp into lumps, which are dried in the sun, or, after wrapping in the leaves of the tree, in the hot ashes. For use this paste is dissolved in water, and the thick liquor thus made has an agreeable acid taste and is at once refreshing and nourishing.

At Cayenne and in the Antilles the juice of the stem is fermented and made into a good wine, called "Vino di Banana." This same juice, when fresh, is rich in tannin and makes a good marking ink, the marking becoming visible only after washing; a fact which any of my readers who have been rash enough to wear a white shirt when working among Bananas will doubtless be able to verify. The juice is also used for colouring leather.

The inner portion of the Banana trunk—that is, the scape or flowering stem as it passes through the folds of the leaves—is also eaten, and is brought into the Calcutta bazaars to the amount of from half a ton to a ton daily.

Plantain meal, before referred to as a digestible and nourishing food for children and invalids, is simple in its preparation. The fruits after being stripped of their skins are sliced longitudinally through the core, and dried; in the sun if the air is dry, or in a slow oven where the air is allowed to circulate. The slicing must be done with a plated or ivory knife, as contact with iron or steel blackens the fruit. The process of drying should be as rapid as possible, a fragrant odour like orris-root, which the meal possesses, depending it is said upon this. When the fruits are thoroughly desiccated, they are powdered by pestle and mortar or otherwise, and the meal sifted. The colour of the meal is whitish speckled with minute dark red spots. Its flavour is bland and pleasant, and as it keeps well, and in the hands of a clever housewife is convertible into many uses. There is no reason why every larder in the colony should not have its plantain-meal canister. Mr. Anderson, writing in *The Technologist* in 1867, says of plantain flour, that it is decidedly superior to arrowroot as a food for invalids and children, in consequence of its nourishing qualities. The presence of tannin in the meal also gives it a value for use in diarrhœa. There is a pleasant soft fulness in the taste of cake or potage made from plantain flour which will always recommend it. Bananas from their bulk and perishable character cannot be transported for long distances from the coast into the interior; but in the form of meal, or dried as figs, they will not only pay to carry, but would doubtless find an extensive market. The yield of meal is variously stated at from 20 to 40 per cent. Upon this point I can bring no personal experience to bear, but am disposed to think from the composition of the fruit, that the higher of the two per centages most nearly represents the produce of meal.

The subject of the Banana and its uses is so large, and of so much more interest to Queensland than, I think, its cultivators are aware, that it becomes a difficult task to restrain, within reasonable limits, what ought to be written upon the subject. Nearly all the Bananas yield valuable fibre;

but upon this phase of the subject, I shall confine myself to speaking of that species, *Musa textilis*, which produces the Manila Hemp of commerce; as much of the information will serve the purpose of any one desiring to test for fibre the species which they happen to grow. The true *M. textilis* or Abaca is not, I believe, yet introduced into Queensland, the various efforts made to import it having hitherto failed. It is said to thrive best on the slopes of volcanic hills, under the partial shade of trees left at intervals. It does not do well in open plains, and not at all in ill drained lands. In good soil, the suckers are planted 10 feet apart, the distance diminishing to 6 feet in inferior soil. The fibre is best just when the flower stem shows itself; but, after flowering, the fibre is both weaker and more difficult to clean. Dr. Hunter gives the following mode of preparing the fibre :—

"Take the upright stem and the central stalk of the leaves; if the outer ones are old, stained, or withered, reject them; strip off the different layers, and proceed to clean them, in shade if possible, soon after the tree has been cut down. Lay a leaf-stalk on a long flat board with the inner surface uppermost, scrape the pulp off with a blunt piece of hoop-iron fixed in a groove in a long piece of wood (an old iron spoon makes a very good scraper). When the inner side, which has the thickest layer of pulp, has been cleaned, turn over the leaf and scrape the back of it. When a good bundle of fibres has been thus partially cleaned and piled up, wash it briskly in a large quantity of water, rubbing it all well and shaking it about in the water, so as to get rid of all the pulp and sap as quick as possible. Boiling the fibres in an alkaline ley (potash or soda dissolved in water), or washing with soap, gets red of the sap quickly. After washing the fibres thoroughly, spread them out in very thin layers, or hang them up in the wind to dry. Do not expose the fibres to the sun when damp, as this communicates a brownish-yellow tinge to them, which cannot be easily removed by bleaching. Leaving the fibres out at night in the dew bleaches them, but it is at the expense of part of their strength. All vegetable substances are apt to rot if kept long in a damp state."

Presuming that other species produce fibres in no material degree different from that of *M. textilis*, I quote the following interesting account of that species from M. Perroutel, Botanist to the French Government in Guadaloupe :—

"The Abaca of the Philippines differs essentially from all the varieties of Banana known. Its stem, which rises from a tuft of shoots, has a height of from 15 to 20 feet, of a dark green colour, and very smooth on its surface. Its leaves are of the same colour, long, and straight, with strongly marked nerves both parallel and transverse. The fruit is small, triangular, resembling abortive bananas, and scattered here and there near the extremity of the fruit stem. It is full of black seeds, almost round, similar to those of the gumbo. The seeds fructify rapidly after planting, and the young plants are strong and vigorous, attaining the dimensions already indicated within the short space of eight or nine months. The plant requires a rich and humid soil, and rejoices in thick forests, at the base of mountains, where it acquires, in a short time, an extraordinary development. I have never seen it in such perfection as on the humid, yet high grounds belonging to M. de Lacharriése (Guadaloupe), notwithstanding its entire abandonment to itself, in the midst of a jungle of other plants. Only two shoots were planted here, about seven years ago, yet now the whole valley is covered with them, so as to resemble a forest. This fact proves sufficiently that the plant is robust and easily cultivated; indeed, that it can be propagated with a minimum of care, to the greatest needful extent.

"No doubt, however, its regular cultivation would be beneficial in many respects, especially if the plants were kept at a reasonable distance apart, so as to permit their full development. In the Philippines, the stems are cut down as near the ground as possible, at the moment they evince signs of flowering, that is to say about eight months after planting. The outer sheath or envelope is then stripped off, leaving the petioles that compose the stem proper. The stem is next split into two, and afterwards into four parts, after which the petioles or layers are stripped off, working from the exterior. Those composing the very interior or heart of the stem are thrown aside, as being destitute of fibres of sufficient strength for economic purposes. The reserved filaments or slips are now pounded with clubs of hardwood, first on one side and then on the other, until the transversal and cellular tissues, and porous and gummy matters are expelled. After this the fibres are passed frequently through a coarse hackle, and washed many times in clear running water, until perfectly free from all extraneous matters. They are then hung over ropes or poles to dry in the shade.

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"As already said, the coarser fibres are used to make cables, which have great solidity and durability. Ropes of great tenacity are also made from them, which are used in many ways, but particularly in rigging coasting vessels. Of the finer sort, tissues or muslins are made of great beauty, which are very dear, even in Manila. I had a number of shirts made from this muslin which lasted me a very long time and were cool and agreeable in use. But it is especially in France that tissues of this material are best made and of greatest beauty. They receive all colours with equal perfection. Veils, crapes, neckerchiefs, robes, and women's hats, all of great beauty and high cost, as well as of wonderful durability, are among the manufactures from the Abaca fibres. Besides these are made various articles of men's wear, such as shirts, vests, pantaloons, &c. Ever since this precious fibre became known in France our vessels have frequented Manila, returning freighted, in fact, with the article. The quantity imported, however, falls far short of the demands of the manufacturer, and its production certainly deserves the attention of all our southern colonies. Its cultivation, as we have seen, is easy, and as regards cost, next to nothing; and there is no reason why it should not become a much more important article of commerce. The Abaca cloth is almost transparent, somewhat rigid, light, and cool to the touch."

As a material for paper making the Banana only awaits improvements, inevitably coming, in machinery for the rapid and cheap extraction of the fibre; when the difficulties surrounding the question of raw material for the enormously increasing demand for paper of all kinds will be probably overcome, so limitless will be the supply of suitable fibre made at once available.

I must not stop to dwell upon the endless uses to which the Banana leaf is put—of wrapping, thatching, mats and baskets, paper for cigarettes, dishes and plates, surgical dressings, eye shades, sunstroke preventing, or on the useful tinder provided by the legions of spiral vessels in the thick portions of the leaf—but will conclude the subject by passing on to the cultivation of the plant.

To say anything upon this subject may appear unnecessary in the case of a plant so universally grown as the Banana. But while there are many growers who thoroughly understand what they are about, there is no doubt that there is also a good deal of bad cultivation; and cases are not wanting where to judge from appearances the Banana is supposed to cultivate itself. The fact is, that there are few plants which so readily respond to intelligent treatment. The Banana delights in rich, deep, and well-drained soils. A

good system of planting is to open a trench a foot or more deep and three feet wide, and in this to plant the suckers from 6 to 8 feet apart according to species. The trench should be from time to time well supplied with fresh cow-dung and abundantly watered. Manure greatly affects not only the increase, but the flavour of the fruit. The trench system is of course not insisted upon where the soil is in all respects suitable; but it has the great advantage of facilitating watering during our prolonged dry seasons. The application of lime to the soil is very beneficial. From the time of planting different varieties bear at different periods, varying from the 4th up to near the 24th month. Three stems are quite enough to each plant. The suckers should never be allowed to crowd each other. If not wanted for transplanting, it is still true economy to cut them off, and with the stems which have fruited to chop them up; leaving the fragments on the surface of the ground until the season comes round for digging or ploughing between the rows. This mulching represses the weeds and keeps the surface of the soil cool and moist. The Banana is a great exhauster of the soil, and where manure is scarce and land is plentiful, it is better to start new plantations every third year. The species the fruits of which contain seeds are rarely edible, and as a rule do not sucker; fruiting in the third or fourth year and then dying off.

Among the inhabitants of some of the island groups of the South Pacific another system is adopted, the results of which are eminently satisfactory, so far as quantity and quality of the fruit is concerned. In the newly prepared ground suckers are put in at about ten feet apart every way. In the second season, when these fruit for the first time, a sucker is removed from each and planted in the intervals. When these latter are fruiting for the first time, the first planted are bearing their second crop, which is allowed to mature, after which the entire clump is eradicated, the place renovated with manure, and a new sucker planted—the second planting, at the five foot intervals, in its turn receiving the same treatment. Thus no plant is permitted to bear more than twice. At first sight there may appear in this method of cultivation to be a waste of labour; but there is economy in the area of land used, while the necessity for a periodical change in the site of the plantation is wholly obviated.

For our sugar planters it may be interesting to mention that the stem of the Banana is sometimes burned and used in the purification of sugar.

BAOBAB, MONKEY BREAD, or ETHIOPIAN SOUR-GOURD.

(*Adansonia digitata.*—STERCULIACEÆ.)

One of the most remarkable trees of the world, attaining a gigantic size, but of very curious proportions. A French botanist—Adanson—from whom it receives its name, speaks of having seen trees twenty-nine feet in diameter and seventy feet high. Other travellers speak of even more grotesque proportions—viz., thirty feet diameter to forty feet height of trunk—in fact, nearly as broad as long. The age of some existing specimens has been calculated at more than 5,000 years; and Humboldt speaks of the Baobab as the oldest organic monument of our planet. Dr. Kirk, the British consul at Zanzibar, a close observer, and one of the most valuable modern contributors to the knowledge of economic botany, seems, however, to think that the basis of calculation has been wrong, and that the Baobab does not attain anything like such an age.

The tree is a native of Africa and Egypt, but has been long naturalised in India, where it was carried by Arab traders, and will probably succeed on our northern coast, although the latitude of Brisbane is too cold for it.

The fruit resembles an oblong gourd with a velvety exterior, and containing a number of seeds about the size of a large pea. These are embedded in a mass of spongy pulp of an agreeable sweet acid flavour, which is much eaten, in texture and taste being something like gingerbread. It is, besides, prepared in various ways and used as a cooling drink, and otherwise as a specific in fevers. In Africa a substance called "Lalo" is made from the pounded leaves, and is largely used in admixture with food to check excessive perspiration and keep the blood healthy. The rind is beaten into a paste and administered in cases of diarrhœa and dysentery. By its use Adanson preserved himself during the five years he resided at Senegal from diarrhœa and fever, which are both prevalent there. The leaves are applied as poultices in rheumatic affections and for ulcers; and the bark has been used with marked success as a substitute for quinine. There is evidently a strong similarity between the economic value of the fruit of the Baobab and that of the "Bael fruit" of India, although the latter belongs to the orange family.

The fibre of the bark is remarkable for its toughness, so much so as to have given rise to a proverb, "As secure as an elephant bound with a baobab rope." It is used for a variety of purposes, as may be supposed; and cordage of all kinds, as well as a coarse kind of cloth, is made from the fibre.

The timber is too light and spongy to be useful, and seems to be applied to no more important purpose than making light rafts for fishing from. As in the case of the Queensland bottle tree (*Delabechia rupestris*), which belongs to the same family, the porous interstices are filled with a mucilage. In the case of the bottle tree this is convertible into a very palatable jelly.

There is one more use to which the Baobab is put in Africa, which is too curious to omit. The tree appears to be subject to attack from a fungus, which vegetates in the woody part, destroys life without altering the appearance of the tree, and renders the part attacked as soft as pith. Such trunks are then hollowed into chambers; in which are suspended the dead bodies of those to whom the honours of burial are refused. The bodies of their poets, musicians, and buffoons, whom they esteem greatly while living, are not permitted burial in the usual manner, because, when living, they were supposed to derive their special gifts from sorcery. These bodies are, therefore, neither committed to the earth nor thrown into the river, as it is supposed that they would prevent either from yielding its fruits. In the baobab trees they became mummies, perfectly dry and well preserved, without further preparation or embalming. Whether this process of desiccation and arrest of decay is partly attributable to any property of the tree or of the fungoid disease which creates the hollow, or is wholly climatic, is not made clear.

The only other member of the family of *Adansonia* is one discovered by Mr. A. C. Gregory, when exploring the sandy plains of North Australia from the Glenelg to the western shores of Arnheim's Land. The measurement of the largest specimen found was 85 feet in circumference at 2 feet from the ground. One main stem measured 35 feet, and another 40 feet in girth. There is a strong resemblance, in all particulars, between the African and Australian species of *Adansonia*—not only in appearance, but the various parts of both are applicable to similar uses. The sheep of Gregory's expedition ate greedily the mucilaginous chips cut from the

living trees; and the men of the expedition, by boiling the internal pulp of the fruit with sugar, provided a remedy which contributed to the rapid recovery of some of their number from scurvy.

Mr. John Pentecost, who accompanied as surveyor an exploring party to North-west Australia in July of last year, thus speaks of this tree:—

"Among the most noticeable of the trees was the Baobab (*Adansonia Gregorii*), which was often met with between the Gulf and latitude 17° S., and near the Fitzroy. These trees commonly grow singly, it being very unusual for two or three of them to be in sight at one time. Being deciduous, those seen during the early part of the journey were devoid of foliage, and in only a few cases had the nuts escaped the attention of the blacks. Though not of great height, generally ranging from twelve to thirty feet, the trunk attains a great diameter; and being contracted at the top and bottom, but protuberant or swelling about the middle, the stem has an appearance very similar to that of the bottle-tree. From this peculiarity of form they were styled 'gouty stem trees' by Sir Geo. Grey, who saw them in fruit, as did also Captain King and Cunningham. We, however, at a later stage of our journey, and when approaching the mouth of the Fitzroy River, had the advantage of beholding the tree in flower and covered with young foliage of a beautiful bright-green hue and large pendulous flowers. The midrib and veins of the digitate leaves were of a lighter yellowish-green. Each flower was about six inches in length, of a slender trumpet-like form and pure white hue, toned with cream colour on the margins of the rounded reflexed edges of the five petals. Projecting beyond the petals and hanging beneath them was a lustrous tassel of about a hundred long glistening silk-like stamens, tipped with anthers of rich red-brown, and encircling a pistil which protruded about half-an-inch beyond them. The style and stamens had their base on an elongated ovary within the corolla of the sepals, three in number; each was rolled back on itself in a perfectly symmetrical scroll, the inner face, that exposed to view, being of a whitish-green colour in one light and creamy green, in another with a satin-like lustre. The flowers were terminal on the stems and surrounded by other flower buds, which, when small, resembled those of the orange flower. The *Adansonia* flowers perfumed the neighbourhood of the tree with a delicious odour, which reminded one both of the jasmine and the sweet-scented violet. When the stem of the tree is cut a white nutritious gum exudes, and the bark, when boiled, furnishes a wholesome mucilaginous drink. For the aborigines it is probably the most useful tree in tropical Australia, and marks of an encampment were usually found around it, with the husks or shells of the fruit plentifully strewn over the ground, after the blacks had extracted and eaten the interior edible mass. In no instance had the trees been injured or in anyway defaced, long poles having been employed for climbing them and for knocking down the fruit. This fruit is commonly the size of an emu egg, with a husk or outer wood shell of a thickness about the same as a shilling, and filled with a whitish floury mass, which is edible; and although at first insipid, it developes a slightly acid, pleasant flavour, on being masticated. By us it was found a very acceptable variety of vegetable food. Embedded in the floury mass were from eight to twelve kidney-shaped seeds, about the size of a small bean, the outer case or shell being hard and woody, the inner portion or kernel having a flavour very like that of the Spanish nut. The natives eat the fruit both as we did without preparation, and by grinding and moistening the flour and nut kernels, which they slightly bake. There are two or three varieties of this tree, but only one was seen in flower and foliage in the month of November."

As the Baobab has been frequently sent northward, and will probably find a home on our coast, the following extract from "Baker's Nile Tributaries," in further description of this tree, may be permitted:—

"Towering over the heads of the low mimosas, the gigantic 'Homera,' or 'Baobab,' could be seen from a great distance. Having steered direct for one, we halted, and dismounted to rest the horses beneath the shade. This tree was about 40 feet in circumference, and the spongy trunk was formed into a ladder by pegs of hardwood driven into its side by the Basé hunters, who had thus ascended the slippery stem in search of honey. Bees are very fond of these trees, as they are generally more or less hollow, and well adapted for hives. The *Adansonia digitata,* although a tree, always reminds me of a gigantic fungus; the stem is disproportioned in its immense thickness to its height, and its branches are few in number and as massive in character as the stem. The wood is not much firmer in substance than cork, and is as succulent as a carrot. In Kordofau, where water is exceedingly scarce, the *Adansonia* is frequently used as a reservoir; one of these huge hollow trees is cleaned out and filled with water during the short rainy season. The fruit was ripe at the time we halted, and after many attempts, by throwing sticks, we succeeded in securing a considerable number. The sub-acid flavour of the seeds, enveloped in a dry yellow powder within the large shell, was exceedingly refreshing."

BREADFRUIT.

(*Artocarpus incisa.*—ARTOCARPACEÆ.)

A large tree, 30 to 40 feet high, 12 to 18 inches in diameter, with large, rough, indented leaves, not unlike those of some of the edible figs. It is the indented form of the leaves which has given this Artocarpus its specific name, "incisa," to distinguish it botanically from the other species, jack-tree, which is called "integrifolia" or "entire leaved."

The habitat of the tree naturally is in the islands of the Pacific and of the Malay Archipelago; but it has long been naturalised in the West India Islands. Historical interest attaches to its introduction to that part of the world, the event known as the Mutiny of the "Bounty" having occurred while the ship was engaged in transporting a large number of plants of the Breadfruit from Otaheite to the West Indies. This effort at acclimatisation had been instigated by the English planters of the West India colonies, and although the first attempt failed through the diversion of the ship from its proper destination, a second experiment made by Captain Bligh in the "Providence" was attended with success, and in 1793 bread-fruit trees were flourishing in the West Indies, where the tree has since become so common as by many to be supposed indigenous to the country.

There are a great number of varieties of the bread-fruit, distinguishable in many ways: by the shape of their leaves, by the presence or absence of seeds in the fruit, by the period of fruiting, by the size of the fruit and the length of the protuberances on the rind. Dr. Bennett lays down the number of varieties at twenty-four, to each of which he gives a specific native vernacular name. It is, however, open to doubt if incomplete observation and differences of dialect do not govern this list to too great an extent to render it a safe guide. That the quality of the fruit should greatly vary is very natural; but in Fiji, at least, the difference in the period of fruiting in the different varieties is so considerable that practically the Breadfruit is perpetually bearing, although not in the same locality.

This does not appear to be wholly the case in Tahiti, there being four months of the year during which the fruit is out of season or scarce. As the natives depend largely for their subsistence upon this product, they resort to several methods of preserving it. By one of these the fruit is gathered half-ripe, and the pulpy part is boiled for a short time, and then hung up to dry in the sun, after which it will keep for twelve months.

Another preparation is thus described by Captain Cook :—

" The fruit is gathered just before it is perfectly ripe, and being laid in heaps, is closely covered with leaves. In this state it undergoes a fermentation, and becomes disagreeably sweet; the core is then taken out entire, which is done by gently pulling the stalk, and the rest of the fruit is thrown into a hole which is dug for that purpose, generally in the houses, and neatly lined in the bottom and sides with grass; the hole is then covered with leaves, and heavy stones laid upon them. In this state it undergoes a second fermentation, and becomes sour, after which it will suffer no change for many months. It is taken out of the hole as it is wanted for use, and being made into balls, is wrapped up in leaves and baked. After it is dressed, it will keep for five or six weeks. It is eaten both cold and hot, and the natives seldom make a meal without it; though to us the taste was as disagreeable as that of a pickled olive generally is the first time it is eaten."

In the fresh state, when baked in the ashes, it is a wholesome, nutritious food, and not unpalatable, being described as like crumbs of wheaten bread mixed with Jerusalem artichoke. When sliced and fried it is stated to be hardly distinguishable from an excellent batter pudding, but must be eaten new, as when stale it becomes harsh and unpleasant.

Although the quality of those varieties containing seeds is not the most esteemed, yet the fact that the seeds themselves, like those of their ally the jackfruit, when roasted or boiled, are as good as a chesnut, is a fair set-off against the inferiority of the fruit. These seeds, with their pulpy membrane, make a good preserve after being fried in cocoa-nut oil and then boiled in a syrup of sugar, being much like the " Marrons glacées " (iced chesnuts) of the French confectioners.

The average size of the fruit is that of a man's head, but it often reaches the weight of 50 lbs. In appearance it is more or less heart-shaped, of a greenish colour, and covered with slightly prominent diamond-shaped points. The inside is a white fibry pulp, becoming succulent and yellowish at maturity. At this stage it contains a great quantity of starch. The fruit is borne on the wood of the largest branches and on the stem of the tree itself.

The bark furnishes a fibrous tissue, which is worked up into clothing, and is put to a number of other uses.

Like the whole family to which it belongs, the Breadfruit tree contains a milky juice, which, from freshly-made wounds in the bark, exudes in sufficient quantities to be put to several uses by the natives. Among these is a strong bird-lime, and it is also of much service in paying the seams of their canoes.

The cultivation of the tree is extremely simple. Dismissing the easy method of raising from seeds, on the ground that varieties producing seeds are not the best, the means of propagation is by suckers or root-cuttings of the most esteemed varieties. The Acclimatisation Society has received root-cuttings, as thick as the wrist, from which numbers of strong plants have been raised. The pieces of root are laid horizontally on, and are covered with, cocoa-nut fibre refuse in a warm corner of the glass-house; and strong shoots appear in numbers. These at a proper stage being removed with a small heel, and potted off, soon make good plants.

The Breadfruit has not yet found a congenial home in Queensland; but it is not unlikely that the hot moist climate and deep alluvial soil of the Johnstone, Daintree, and other northern rivers will prove suitable to it, and that we may yet triumph, after repeated failures, in establishing on our coast one of the handsomest, most curious, and most useful trees of the world. The tree insists upon rich moist soil in sheltered situations, as well as upon a moist hot atmosphere; and unless these conditions can be secured together, success is not likely to be attained.

BREAD-NUT.

(*Brosimum alicastrum.*—ARTOCARPACEÆ.)

A high tree, with a tall straight trunk, a native of Jamaica, in the woods of which it is of common occurrence. The pale yellow flowers are followed by yellow fruits, about an inch in diameter, like a plum, containing a single nut-like seed. This nut, roasted or boiled, rivals the chesnut, being of agreeable flavour, farinaceous, and easily digestible. The negroes depend much upon it for their support in seasons of extreme drought, when their ordinary food supplies fail. The Bread-nut tree appears to be able to withstand a long continuance of dry weather without any lessening of its fruit product, and should therefore be a valuable introduction for Queensland.

The value of the tree as a food producer would seem to have been determined from the first; the name "Brosimum" being taken from a Greek word meaning eatable.

The foliage is handsome; the leaves being lance-shaped, dark-coloured, and glossy.

The leaves and young branches are very valuable as a fodder. They contain a good deal of a gummy sort of milk, for which reason they are disagreeable to cattle at first; but after overcoming the first prejudice, animals become extremely fond of this fodder, which is wholesome and highly fattening.

The timber has a fine grain like mahogany and is used by cabinet-makers in the West Indies.

The Bread-nut was introduced some years ago by the Acclimatisation Society; and healthy young trees may be seen at Rockhampton and elsewhere on the northern coast.

CAJEPUT-OIL TREE.

(*Melaleuca Cajeputi—Melaleuca Minor.*—MYRTACEÆ.)

Any one familiar with the white-barked "tea-tree" of Queensland, swamps will be able to picture to himself the subject of this article; the species of melaleuca from which the cajeput oil of commerce is made being very similar to our own old acquaintance in every respect, except that it does not attain so large a size.

The species in question is a native of the Moluccas and other Indian islands, is a moderate-sized tree, with a willow-like foliage and a pale-coloured bark, consisting inside of many flakes of a delicate tissue like paper. The flowers, which are whitish and of no interest, are produced upon a long spike, on which they sit close without stalk. It was for a long time matter of doubt from what plant, and afterwards from what part of the plant, cajeput oil was obtained; and it was not until after these points had been

determined that the best authorities ultimately agreed that the tree producing the staple article was a distinct species of *melaleuca*. This species has been imported several times in quantity into Queensland from Java, and has been freely distributed. At least one good specimen may be seen at Bowen Park. Although a free seeder, the seeds germinate shyly under artificial sowing; but plants come up freely about the mature tree, and cuttings of not too ripe wood will strike freely in a sandy soil. Slender pieces of the root also, cut into small bits and laid horizontally in the ground during the rainy season, soon produce plants.

The oil is volatile, very limpid, pellucid, of a peculiar pale-green colour, and burns without residue. It has a powerful and fragrantly aromatic perfume of a very penetrating character. If used in one room, its odour is perceptible in remote corners of a large house. Its use is confined wholly to medicinal purposes. As an embrocation it is valuable in rheumatism, local paralysis, and gout. For the first-named complaint it has often been used with marked effect by two generations of the writer's family. As an internal medicine its application covers more ground; its action being anti-spasmodic and stimulant, and inducing profuse perspiration. At one time it was regarded as a specific in cases of cholera, and the demand was so much in excess of the supply as to have led to adulteration, and indeed to imitations which were wholly spurious. This was no difficult task, as in the pure article the savour of camphor, rosemary, and cardamoms is distinctly observable, with a slight dash of turpentine; so that skilful combinations of some or all these produce an article sufficiently like to require the skill of the analyst to detect the fraud. A few drops of the pure oil produce a sensation of warmth in the stomach, an increased fulness and frequency of the pulse, and a more or less profuse perspiration, according to the quantity taken. Besides the ailments already referred to, it is used in low fevers, spasms, and colic. Pereira thus speaks of cajeput oil:—"As a diffusible stimulant it is useful where we wish promptly to raise the energy of the vital powers, especially when at the same time any spasmodic movements are to be allayed. As an anti-spasmodic it is a very efficacious remedy, in painful spasmodic affections of the mouth and in flatulent colic. As a stimulating sudorific it proves occasionally useful in chronic rheumatism, painful affections, and local paralysis. Dose, from 2 to 10, or even more drops may be taken on sugar or an emulsion."

Having described the tree and the use of its staple product, and again reminding my readers that plants have been repeatedly distributed, and ought to be found in many gardens on the northern coast, it only remains to describe the simple process by which the oil is obtained. The leaves are gathered on a warm day and put into sacks where they get hot and damp. They are then steeped in water and left to ferment for a night; after which the oil is obtained by distillation in the ordinary way. Some bruise the leaves as a first process in place of the fermentation in sacks, but the method described is the most simple as requiring least labour, and producing the result intended to be attained of preparing the material, so that the volatile oil may come off more freely in the still. The quantity of the product bears a very small proportion to that of the raw material required—two sackfuls of leaves barely yielding three drachms of the oil--which is therefore not plentyful and is rather expensive. By a further process of rectification the oil can be made colourless; but this is rarely done, as the natural colouring matter is harmless and does not affect the properties of the oil.

In China the leaves are used as a tonic, the virtues being partially extracted by simple decoction.

Pure cajaput oil has the property of dissolving caoutchouc, an excellent varnish being the result. The oil is also valuable as a preservative of natural history specimens from insects.

The timber, like that of the Australian species *Melaleuca leucadendron*, is hard, close-grained, and almost imperishable underground. The bark also is put to similar purposes to that of its useful Australian relative, but in addition to these, in the Moluccas, is used as oakum for caulking boats; and the natives of India use flakes of the bark for their sacred writings. I should add that other trees of the species yield a similar oil, but not in quantity sufficient to be worth extracting.

The tree grows successfully, blossoms, and ripens its seed perfectly in Bengal; and doubtless will do well on our coast.

CALABASH TREE.

(*Crescentia Cujete.*—BIGNONIACEÆ.)

A tree attaining the height of twenty feet, native of the West Indies and tropical America. It is more curious than handsome, both in foliage and flower; the leaves are borne in tufts, and the flowers are large and variegated with several colours, but of dull effect.

The wood is light, tough, and pliant, but it is only procurable in very narrow planks. It is much used for coachmaking, saddles, and furniture.

There are several varieties of the tree, producing fruit varying in size and shape from two to twelve inches in diameter, and round, oblong, or bottle-shaped; that most used is a fruit large enough, when the shell is cleaned out, to contain a gallon of water. The external shell is very hard and woody, and is used for bottles, basins, cups, and kettles. In the latter capacity it can be put on the fire for boiling water, several times without injury. The shell is also cut into button moulds, spoons, and a host of other articles, and is often carved and polished for ornamental purposes.

In the inside of the fruit is a subacid pulp, enveloping a great number of flat seeds, which is eaten by the natives. It is slightly purgative, and is reputed to possess virtue for diseases of the chest. The pulp roasted and applied to a boil soon ripens it.

The leaves, which are borne plentifully, are greedily eaten by cattle; which in dry seasons also eat the young green fruit.

The expressed juice of the fruit in a dose of about a quarter of a pint, makes an excellent purgative; and it is considered to be efficacious in pulmonary complaints. For the latter purpose, the young fruits are roasted, and the juice squeezed through a coarse cloth. To a pint of juice a pound of sugar is added, and boiled into a syrup. Of this syrup a table-spoonful is administered two or three times daily by itself or in barley-water.

A specimen of the tree may be seen in a sheltered nook at the rear of the residence at the Enoggera storage reservoir; and at the "Macknade" plantation on the Herbert the calabash tree has been successfully fruited.

THE CAMPHOR TREE.

(*Cinnamomum Camphora*—LAURACEÆ.)

This tree, which is the principal source of the camphor of commerce, is a native of Japan and China, and is also found in the East Indies. It is a majestic tree, much branched, attaining the height of 40 to 50 feet, in general

aspect not unlike the English lime-tree. The leaves have an acute lance-like shape, and are on long footstalks—a pale yellowish and glossy green on the upper surface, but greyish below. The flowers are white and inconspicuous; the fruit being, like that of the cinnamon, a small olive-shaped berry, but the tree does not blossom until it attains a considerable size and age. From the authority of a botanist long resident in China I learn that in many parts of China and Japan it is one of the most abundant timber trees. The camphor is obtained by a process of dry distillation. The wood is split and broken into small pieces, and distilled in water in an iron retort covered with a wooden or earthen top, in the hollow of which is deposited hay, or rice straw, to which the camphor adheres when deposited by the steam. The first product is crude and impure, and the deposit is in very small particles, and it requires re-distilling for the production of the camphor of commerce. In this second process the crude product is mixed with quicklime, which detains the impurities, and the pure camphor is sublimated in the cup-shaped lumps in which it is sold.

The value of the timber—coming to us as it does in so many forms from the East—is well known. It is light, easily worked, and durable. It is not itself liable to insect attack, and in the form of drawers and boxes is preservative of papers and woollen fabrics from the attacks of some insects; but having relied upon it one year for preserving seeds, I found to my cost that the common weevil is not in the least prevented by camphor-wood from destroying seeds. It is, however, decidedly useful as against moths, silver-fish, and insects of delicate organisation; but even in camphor-wood trunks woollen articles must be periodically examined for moth. Camphor oil is obtained both as a product of distillation and by incisions in the trunk.

There are many other species of Laurus in which camphor is found, but not in quantities which would pay to extract. There is, however, another tree to which, although not likely to find a home in any part of Queensland, I must shortly refer as being the source of large quantities of camphor of a very high class and fetching very high prices amongst the wealthy Chinese and Japanese, who are its principal consumers, and who attribute to it superior virtues, which it, in fact, only possesses to a moderate extent, over the product of the other tree described. The tree in question is *Dryobalanops camphora*, a native of Borneo, Sumatra, and the Malay Archipelago, but of comparatively local habitat, not being found at all south of the line, and not further north than the third degree of latitude. The camphor from this tree is found in flakes and lumps in the fissures of the wood, but as by no means every tree contains it, many are uselessly sacrificed in the search.

THE CAPE CHESNUT.

(*Calodendron capense.*—Rutaceæ.)

This tree is a native of South Africa, and possesses peculiar interest, if only that its very name, which is a compound of two Greek words meaning "beautiful tree," points to it as worth a place in our gardens. The beauty of the tree is not confined to flower, foliage, or form; but it excels in all these; and, as though that were not sufficient to stamp its excellence, it also produces an edible nut.

The foliage is peculiarly dense, and of a rich dark-green, very grateful to the eye. After the first year or two it rapidly attains a height to be of service as a shade-tree, for which purpose it excels where a tree is required that is manageable in form and size. The flowers are large and striking, resembling a good deal some of the variegated lilies. The tree possesses the further advantage that it will thrive in shallow, poor soils.

The tree is called *Wilde Kastanier* (wild chesnut) by the colonists of the Cape, where it is held in high estimation. The seeds are about twice the size of a large hazel nut, black and shiny on the outside, but otherwise in form and appearance, and also in flavour, much like the common chesnut.

It comes true from the nut, which has been successfully imported several times by the Acclimatisation Society; and it also grows freely from cuttings.

Handsome specimens may be seen at Bowen Park; and, as an evidence of the strong vitality of the tree, it may be mentioned that the largest of these was twice levelled to the ground by gales, but hardly suffered at all by its rough treatment.

THE CAROB.

(*Ceratonia siliqua.*—LEGUMINOSÆ.)

This interesting and useful tree, which attains a height of 30 to 50 feet, is a native of Southern Europe, Egypt, Asiatic Turkey, and all the Mediterranean coast. It is known by the various vernacular names of "carob," "algaroba," "St. John's bread," "locust bean," "sow's bread," and "camel's bread." The two latter indicate its specific use in some countries for feeding the animals referred to; but it is also largely used as a fodder for horses, mules, asses, and cattle. When fed to animals, however, it should only be used as an ingredient, not being wholesome when given in large quantities. The unripe pods are very astringent, and are not only unwholesome but dangerous to animals eating them. It enters, moreover, largely into the manufacture of artificial food for animals. It is a well-known historical fact that in the Peninsular War of 1811 and 1812, the Carob bean formed the principal food of the British cavalry horses. In countries to which it is native, or where it is generally cultivated, the Carob is put to various uses for the purposes of man—at Valenza the chocolate makers introduce the flour of the bean into inferior kinds of chocolate; and in Barbary the pulp of the fruit is mixed with barley and wheaten flour, and made into bread. Decoctions are prepared from it which are frequently used in cases of cold in the chest, and generally in combination with dried figs in their medicinal uses. It is employed also as a mild laxative like the Tamarind; and in Calabria the pulp is used as an ingredient in the manufacture of liquorice. The Arabs use it instead of sugar in the preparation of confectionery, and they also extract from it, by means of fermentation and distillation, a kind of spirit. The bark of the tree is employed medicinally; being administered in the form of an extract in cases of diarrhœa, in doses of 30 to 50 per cent. Carob beans also contain butyric acid, which enters as a principal ingredient in the manufacture of artificial essence of pine-apple. In Portugal, so largely does the Carob bean enter into domestic and farm use, as to make failure of the crop from drought equivalent to wide-spread ruin.

Both in England and in countries where they are grown Carob pods are used largely for the manufacture of a sort of brandy. Twenty-five parts of broken and macerated pods are added to sixty-five parts of water and submitted to regular fermentation. The liquid obtained by separation from

the lees is distilled and chemically rectified, yielding $10\frac{1}{2}$ per cent. of spirit; and the precipitation from the first distillation yields another $1\frac{1}{2}$ per cent., making a total of 12 per cent. The original spirit has the flavour of the pod itself, to which, however, the palate soon becomes accustomed; but this flavour is easily disguised by juniper berries or aniseed, and the spirit converted into gin or liqueur.

The tree is of slow growth and the wood extremely hard and durable and takes a good polish.

The Carob is an evergreen of rich dark foliage and possesses no mean capabilities, if properly trained, as a shade tree. "In Liguria," says Prof. Pfluckijer, "a dense crown of foliage, rising from powerful knotted stems, shines out in the midst of an olive grove, or alone on the sunny shore, spreads out its half-bared roots often over a surprising circuit. This is the *Ceratonia siliqua*." It adapts itself to all kinds of soil, provided they are dry. It thrives well on stony ground and on limestone rocks, also on dry clay lands and volcanic lava; and the roots attach themselves so firmly to the soil that, in Spain, even in the most exposed situations a tree has never been known to be torn up by the roots. It will, of course, grow to perfection, and attains an immense size, in rich, deep, well-drained and friable soils, but in marshy or damp situations it will not prosper. The Carob resists the effects of drought wonderfully; remaining unaffected while the Olive droops and other plants die from excessive heat and want of moisture.

Preserving the leading condition of success insisted on, namely, unrestricted root run and perfect drainage, the Carob will yet respond nobly to high cultivation; benefits even by watering in dry seasons, if done with judgment, abundant care being taken that the water drains away quickly and does not hang about the roots of the tree.

The Carob tree sometimes produces flowers containing both the male and female organs; sometimes male and female flowers separately on the same tree, and again, some trees produce wholly female or wholly male flowers. This, of course, renders uncertain the sex of seedling trees, and makes propagation by seed an unsafe method. To ensure, therefore, the fruitfulness of all the plants, it is necessary to graft them, and this is done when they are still in the nursery and have reached the height of about 2 feet. The scions must be those from a fruit-bearing tree, and the two methods of grafting preferred are budding and stem grafting. The removal from the nursery to the plantation must be done whilst the plants are still young, it being indispensable for success that they be moved with a large ball of earth. As the plants become older they are less manageable, and the operation becomes more difficult. From the nursery the plants are put into a plantation about $3\frac{1}{2}$ feet apart, and at the age of 4 or 5 years they are removed to their permanent position; requiring in the process even still greater care than before. Good form for the trees is attained by judicious pruning.

The above practice is not, however, universal. In the neighbourhood of Naples, where the Carob is largely cultivated and with considerable profit, the growers sow the seed in little pots, one seed in each; and as soon as germination is certain, they plant the pot where they wish the plant to grow permanently. The root soon breaks the pot, and the plant is secure. The plants are ultimately grafted where they stand; but this practice of grafting is not universal, as some hold that seedlings from well cultivated trees are always fruitful. The flowers are generally borne on the older branches, and sometimes even on the stem. The fruit, which is at first green, changes as it ripens to a chocolate colour. The pods are collected by hand or beaten down with a pole. When gathered they are spread out on the floor of dry and well ventilated rooms, or laid in alternate layers with

straw. If collected in heaps, they ferment and turn black. They must be quickly made use of, or they will fall to pieces, become white and worm-eaten. The annual yield of an adult tree is from 8 to 20 cwt.; and full-grown trees may be seen bending under the weight of their fruit.

The pods vary in size up to 10 inches long, 1 in. wide, and $\frac{1}{3}$ in. thick, flattened and often oddly curved. When ripe they are of a chocolate colour and glossy; the contents being a dry mealy compact substance honey tasted, and embedding five or six large flat oval light-brown seeds.

The tradition that the fruit of this tree constituted part of the food of St. John in the wilderness, and which is the origin of the name "St. John's Bread," is discarded by the best authorities. There is no necessity whatever to reject the theory that the word "locust" referred to an insect, as there is abundant evidence that insect locusts of more than one species were eaten. There is, however, good reason for supposing that the "husks" spoken of in the parable of the "Prodigal Son" referred to the dry residuum of the Carob bean, after expression of the honey, which was used as food for swine.

In Malta the Carob is the predominant tree; and from Cyprus and Crete large quantities are annually exported. From the latter island alone in 1874 180,000 tons were exported, the large proportion of which found its way to England.

As to climate, it may be said with tolerable accuracy that the Carob will succeed where the Orange can grow without protection in the winter; and there is no doubt that it is less hardy than the Olive, and will not thrive at elevations where that tree is productive.

THE CASHEW-NUT.

(*Anacardium occidentale.*—TEREBINTHACEÆ.)

This is a handsome tree, a native of the West India Islands and tropical America, but now common to the tropics, generally near the sea-coast, where the soil consists of little else than sand. It is never so much at home as in hot plains, exposed to the full blaze of the sun. It is a tree of quick growth, attaining a height of 15—20 feet, bearing in three years, the trunk being short and often crooked, and the bark rough and cracked. In addition to the beauty of its foliage, the Cashew bears compact heads of sweet-smelling flowers, and it flowers twice a year. The timber is of no value except for such rough purposes as packing cases, but makes excellent charcoal. The fruit consists of two distinct portions, viz., a nut—which is the true fruit—of a leaden-grey colour about the size and shape of a hare's kidney, with compressed sides. This nut is attached to a fleshy, smooth, orange-coloured "hypocarp," or "underfruit," of the size and shape of a small pear. This latter portion, which is known as the "apple," is succulent, and is used in various ways, but appears to vary in excellence; the produce of some trees being astringent, while the fresh fruit of others is delicious, with an agreeably acidulous flavour. Stewed with sugar it makes an excellent preserve, but its best form is when candied, in which state it is hardly distinguishable from Eleme figs. The expressed juice makes a pleasant wine, and distilled makes a spirit much superior to rum, but a powerful diuretic. This underfruit, roasted, is regarded as imparting an admirable flavour to punch. The juice of the flower-stalk is acid, and is converted into a sort of lemonade. It is also by fermentation made into wine and vinegar.

The principal product of the tree, however, is the nut, which, from the frequency with which it is to be seen exposed for sale in the grocers' shops in the old country, is doubtless familiar to many who may have never seen the tree. The outside shell is hard and tough; and between this and an inner film which protects the kernel, is deposited a black acrid inflammable oil, of a highly caustic nature. The kernel itself is very delicate eating, and in getting rid of the oil, so as to leave this uninjured, some art is necessary. When properly prepared, however, it is one of the favoured delicacies of the West Indies, being used in various ways. A recent writer, dating from Jamaica, in one of the horticultural journals, says, that to prepare for use, the nuts are placed in a shallow, thin metallic vessel over a slow fire in the open air. They are heated until the oil takes fire and are stirred briskly until it is consumed. Being then removed from the fire, they are carefully cracked, and the kernels placed in hermetically sealed bottles until required for use. This writer, Mr. J. Hart, whose statements I have had occasion to test more than once, and have always found reliable, says that thus prepared the kernels of the Cashew-nut are equal, if not superior, to any nuts found on the best tables in European countries. They are commonly sold in Jamaica prepared in sugar in the same ways as almonds, and from being accredited with having the effect of exciting the faculties, especially that of memory, this preparation is called *Confection des Sages.* The kernels are also used as an ingredient of puddings and in various other ways in cookery ; and they also enter largely in the preparation of chocolate as an adulterant, and themselves—apart altogether from the other oil referred to—yield a very good edible oil. A further valuable application of the kernels consists in drying and breaking them up and mixing them with Madeira wine, the flavour of which they greatly improve; and they are imported into England ready prepared for this purpose.

Just before and during the time of flowering, a transparent gum, in quantity varying from 5 to 12 lbs. per tree, exudes from the bark, of much the same characteristics of, and equal in quality to, gum Arabic, but rather astringent. It makes an excellent varnish, and seems to possess especial virtue in preserving from insects; for which purpose a solution of it is used by bookbinders in South America.

The sap obtained from incisions in the bark of this, as in the case of some other species of the order, makes an indelible stain upon linen ; and so powerful is this effect in the *Semecarpus anacardium*, a near relative of the tree under description, that it derives its common name of "marking nut" from that property—the unripe fruit, in conjunction with quicklime, being used for making an indelible marking ink. The bark of the tree has been used for tanning, but does not enter into that industry to any material extent.

But the most remarkable product of the tree is the acrid oil, the presence of which, underneath the outside husk of the nut, has been before referred to. This oil, known in commerce as "cardole" or "cashew apple oil," is of such a caustic nature that if it comes into contact with the lips, blisters immediately follow ; and the process of roasting the nuts is conducted in the open air, as the mere fumes from the oil are apt to produce painful swellings and inflammation of the skin. This acrid blistering property gives the oil a specific value. It is used with great success as an application to ringworm, ulcers, corns, and warts; but must naturally be applied with caution. The bark and the juice of the apple are put to various purposes in medicine. One of the most important uses of the oil is as a preservative of timber against white ants, for which it is said to be perfectly effectual.

Lindley makes Martius responsible for the statement that the sympathetic effect which the nut, borne about the person, has upon chronic inflammations of the eyes, especially such as are of a scrofulous nature, is remarkable. As the tree is bearing on the Herbert River and elsewhere on our northern coast, this assertion can be tested by the simple process of carrying a few nuts about in the pocket; and the experiment is worth trying.

I must not leave the subject of this most interesting tree without giving my lady readers the opportunity of learning a virtue of special interest to them lying in the Cashew-nut. The young ladies in the West Indies use it as a cosmetic when they become much tanned. They take a nut, scrape off the outside skin, and rub their faces over with the exposed oily surface. The face swells and blackens, but ultimately the tanned skin peels off; and, although the process necessitates rigid retirement for a fortnight, at the end of that time they re-emerge with a new skin and a complexion as fair as a babe. For this statement Robert Hogg, writing twenty years ago, is responsible.

CASSIA BARK.

(*Cinnamomum Cassia.*—LAURACEÆ.)

This is a native of all the countries to which the true cinnamon* is indigenous, and has a still wider habitat than that tree. It is a larger tree, attaining a height of sixty feet, and has a very wide spread of branches—in other respects very much resembling the cinnamon. The leaves are deep green on the upper and grey on the lower surface, the flowers being somewhat more bell-shaped than the other. It likes similar soil and treatment to that which suits its more important and valuable relative; and, in fact, the two trees differ little from each other beyond the points above-mentioned, except as to the degree of the aromatic principle in the bark. In this respect the tree under notice is greatly inferior, the price of high-class cinnamon being double that of cassia bark. This latter is thicker in substance, less quilled, and breaks with a short instead of a splintery fracture. It is also far more pungent than cinnamon, and has a slimy, mucilaginous feel in the mouth when chewed. Most of the cassia bark imported comes from the East Indies, and it is principally used for the essential oil which it yields by distillation.

CASTOR-OIL PLANT.

(*Ricinus communis, or Palma Christi.*—EUPHORBIACEÆ.)

This well-known plant gets its name of "Ricinus" from the similarity of its seed in appearance to the insect "tick," and its more elegant designation from the palm-like shape of its leaves. It is a native of the East and West Indies, Africa, South America, and of the warmer countries of Europe; but is largely cultivated in the East and West Indies, in France, Italy, Spain, and in the Southern United States. It is a hardy plant, and thrives alike on the plain and the mountain. The duration of life, however, and the size attained by the plant vary much in different countries; while it is an annual reaching only a moderate growth in cool climates, in hot countries it

* See article on "Cinnamon."

becomes a tree 20 feet high, often attaining that height in one year from the seed. In Spain it has been seen with a trunk as large as a man's body, and a reliable authority speaks of it as attaining in Sicily the size of an English alder-tree, being woody and long-lived. We need not, however, go out of Queensland for either large or old specimens.

In Java the Castor-oil plant is cultivated with the mountain rice, being thinly interspersed with the rice, with the growth and harvesting of which it does not materially interfere. There is some doubt whether these large and woody specimens are distinct species, but the probabilities are in favour of the theory, that climate is solely responsible for the variability in size of the Castor-oil plant.

In a country like Queensland, where the plant is a common weed on any waste piece of land with suitable soil, familiarity with its appearance has bred contempt; but in countries where it cannot survive the winter, it is a great favourite, its handsome palm-shaped leaves, its umbrageous and stately habit, and the shiny purplish appearance of the stem, eminently adapting it for ornamental planting during the summer season. The gardeners of Europe have now in use for this purpose many varieties differing in height, spread of foliage, size of leaves, and colour of flower; some of them being exceedingly handsome. It is, however, with the plant in its economic phases alone that I desire to deal; and the varieties chiefly known to the oil-grower are two, one with large and one with small seeds. The small-seeded variety has the credit of yielding the best oil; but there is probably little if any difference in the value of the oil between the two varieties, the quality of the product depending wholly upon the method of extraction and after-treatment. The opinion that there is a material difference in the quality of the oil from the two kinds is strongly entertained in India, and on the other hand is lightly regarded in the United States; but one season's experience will easily settle the question for the intelligent colonist who leads the van in establishing so sure and profitable an industry as the production of Castor oil in Queensland.

The root of the plant being long, thick, and fibrous, a light sandy loam is naturally the best suited to it; but wherever wheat or maize will thrive, the Castor-oil plant can be successfully grown. The soil, however, must be dry. Wet heavy soils are not adapted to it. In America, the cultivation of castor beans is considered to be highly fertilising to the soil, and in this respect to surpass clover. It is even asserted that a crop of castor beans taken off land enhances its value by several dollars per acre in consequence of the additional fertility imparted to it by the crop; and the belief in the efficacy of the plant as a fertiliser is so strong in some minds, as to have led to the free lending of land for the purpose of taking a crop of castor beans off it. The method of cultivation in different countries does not differ in any principle, and in describing it, for the use of the Queensland farmer, I select from good sources the system in operation among the Americans; as it is in all respects good, and involves neither waste of labour or of area of land. In the cooler States, where the plant is an annual, and the crop is easily killed by frost, it has to be got off the ground while the season is still warm; the seeds are sown, as early in spring as possible, in hills 2 x 3 feet apart, two seeds in each hill. In the Southern States, where the seasons are longer, and the plant assumes the dimensions of a tree, the hills are not less apart than 6 feet by 3½ feet; one seed to a hill, covered 2 inches. One thorough ploughing, followed by three or four harrowings with a heavy harrow, is sufficient preparation. If the soil is at all inclined to be wet, it is thrown into back lands, 15 to 20 feet in width, and the dead furrows between these are kept open to act as drains for the surface water. The

ground is then laid off in rows according to the distance required by climate, a distance of eight feet being left between every sixth or seventh row, one way, as a cart road to facilitate gathering. Good sound plump seed is selected, and before sowing, hot water is poured over them, and they are left to steep for 24 hours. Without this part of the process the seeds are apt to germinate irregularly, and as a further precaution more seeds are sown to a hill than are required, the weaker plants, if more than one come up, being weeded out. The after cultivation consists in keeping down weeds, in keeping the soil open and mellow, and in slightly hilling up the plants, but with a nearly flat surface. After the plants attain a height of two feet, they can be left to themselves. The cultivation is as simple as that of Indian corn.

The outer coats or pods of the Castor bean, as they become dry in the process of ripening, burst open suddenly, thereby causing the seed to scatter—a peculiarity which demands a special method in harvesting the crop so as to save loss of seed or unnecessary labour in gathering the fallen beans. The spikes are accordingly cut entire as soon as the pods begin to turn brown. They are then taken to a well-enclosed yard with a warm aspect, the surface of which has been rolled down to facilitate the collection of the beans after they have been discharged from the pod. The spikes are occasionally turned over and exposed to the sun until the husks are all empty, when they are removed, the beans being swept up, cleaned by fanning, bagged, and stored in a dry place. The greatest care is taken to prevent the beans getting wet. When rain is expected everything is raked together and the heap covered up with boards or other material kept handy for the purpose. The work of gathering, drying, and cleaning is all light, and can be—and, in fact, much of it is—done by children.

The method of harvesting above given is important for the purpose of this article, because it is simple and cheap and suited for pioneer efforts upon a small scale. Where, however, large areas of fifty or more acres are engaged in the cultivation, a drying-house properly constructed is found to pay. Any ordinary frame building can be adapted for the purpose of constructing a drying-floor composed of battens laid a quarter of an inch apart, except over the stove, where they should be close. The floor should be as near the ground as possible, consistently with being able to work underneath. On one side, two or three feet above the floor, is placed a door for taking in the spikes from the dray. Near the door on the lower floor a stove is erected, and a hot-air pipe is taken thence under the drying-floor to the upper side of same, returning again to the front, and ultimately passing out through the roof. With a large wood stove, the heating may be increased by carrying the pipe entirely round the building, three or four feet from the walls, before it passes through the floor, and again to the rear before going out through the roof. A Turkish bath affords a good illustration of how thoroughly rooms can be heated by means of hot-air pipes. As the pods open and the beans are discharged they fall or are swept through the openings between the battens on to the floor beneath whence they are gathered, and after being winnowed are bagged. The hulls and spikes make good fuel. The yield of beans depends upon various considerations—season, care in cultivation and in the gathering and ripening of the seeds, being all elements; and the yield varies between 15 and 25 bushels to the acre.

In different countries there are, as may be supposed, variations in the methods of procedure; but as these involve no principle and are many of them primitive and wasteful of labour as well as of product, the reader is not troubled with them.

Extraction of the Oil.—The oil is obtained in various ways, viz., by expression, by decoction, and through the agency of alcohol; but the principal method for the purpose of commerce is expression by hydraulic machines. The term "cold-drawn castor oil" applies theoretically to oil obtained by simple pressure, without the agency of heat, which, if applied in excess, injures the quality of the product, and renders it liable to become rancid. But the extremely viscid character of the first product makes its extraction unaided by heat very difficult; and in practice heat in some form is always an element in the process. Before proceeding to crush the beans, the hard external skin has to be removed. This, upon a small scale, may be done in a mortar, but in the manufactories the beans are passed between two revolving rollers, the distance between which is carefully gauged so as only to break the cuticle, which is afterwards separated by a powerful winnowing machine. So important is the perfect separation of the skin regarded that in Florence, after being winnowed, the seeds are further sorted by children, who reject those from which the cuticle has been imperfectly removed, as well as the damaged and rancid grains. The cleaned seeds are then placed in strong, coarse hempen bags about 14 inches wide, which are subjected to pressure in hydraulic presses at a temperature of 70° Fahrenheit. The presses contain from 20 to 30 bags, of a thickness of rather less than 2 inches each. Between each layer is placed a sheet of iron, heated to 90°. The oil which flows from this pressure is of first quality. The marc is then broken up, and again pressed in the same way; the iron sheets being this time heated to 100°. This second yield is of inferior quality, and is kept by itself. The first quality kept in a warm place for a few days deposits a fatty and mucilaginous sediment, from which it is drawn off. It is then put into filtering bags, the mouths of which are tied up, and they are laid on tin-lined shelves, and the pure oil runs through tubes into vessels placed to receive it. The total yield by this process is stated at 40 per cent. In a letter to the *Courier*, some few years ago, the late Mr. Behrens drew attention to a new process patented for the extraction of the oil by which a return of no less than 75 per cent. was obtained. I have not, however, been able to verify this statement. There is no doubt that the character of the season affects the yield, but no one has ventured to explain the exact causes of this difference or their operation.

By another system the blanched seeds are submitted to a *gentle* heat in a shallow iron reservoir, and then pressed. The whitish oily liquid thus obtained, mixed with a considerable quantity of water, is boiled for some time, by which means the mucilage and starch are dissolved in the water, and the albumen is coagulated, the latter forming a whitish layer between the oil and the water. The clear oil is then removed and again boiled with a very small quantity of water. At the exact point when the water has all boiled away, which is indicated by bubbles ceasing to rise, the process is stopped, as every care must be taken not to push the heat too far. In the West Indies the oil is often obtained by bruising in a mortar and boiling in bags under water—the bags acting as strainers to prevent the impurities passing through, and the oil rising to the surface. The oil is then again strained, cooled, and bottled; this method being considered a very good one on a small scale.

The use of cocoa-nut milk mixed with the water in boiling, is considered to affect the quality of the oil very favourably.

Besides the methods of purification by rest, decantation, and filtration, much of the oil used in medicine is bleached by exposure to light in large, nearly colourless, glass bottles. The purgative properties of the oil by this process are somewhat lessened, but removal of colour makes it more marketable.

The extraction of the oil by means of alcohol being expensive and not resorted to for commercial purposes, need not here be described.

Oilcake.—The exhausted marc makes an excellent manure, and is largely used for that purpose in Southern Europe, especially for hemp and flax. Forty bushels to the acre makes a good dressing. The fertilizing property is supposed to lie in the farina of the cake, and not in the residuum of oil and fatty matter.

Medicinal and other uses.—The medicinal value of the castor-oil plant is by no means confined to the oil. For internal administration medical opinion testifies that the oil is speedy and certain in operation, and being free from acrimony may be employed in cases where most other purgatives would be improper, as in inflammatory affections of the alimentary canal, where it acts as an emollient.

Various methods are used for overcoming the nauseous taste of the oil, such as taking it with coffee, spirit, yolk of egg, cinnamon water, &c., but a better way still is to mix the oil with some alkaline lye, which alters the appearance and disguises the taste, but does not affect the purgative property. If castor oil becomes rancid it may be purified by magnesia. The Chinese cultivate the plant largely, using the product as an esculent oil. This is explained in two ways. By some it is said that the oil is a species found in China with smooth fruit, the seeds of which produce a bland oil; and by others, that the Chinese possess some means of divesting the ordinary oil in part, if not entirely, of its medicinal properties. The second of these theories is the most probable.

The seeds are never used now as an internal medicine, as they possess so much acridity as to be almost as dangerous as some other members of the family. The oil even becomes poisonous if the seeds are long boiled, as a high temperature undoubtedly developes the acrid matter. Pereira illustrating this property, gives the following cases: A man masticated a single seed at bed-time, and next morning was attacked with violent vomiting and purging which lasted the whole day. Another case is quoted in which the life of a woman was endangered by eating three seeds, and a third in which a girl of 18 was killed by eating about twenty seeds. As an outward application the crushed seeds are used by the Chinese in a large number of diseases. The pulp is rubbed into the temples in headache, into the palms of the hands in paralysis, and also on to the soles of the feet to hasten childbirth. It is stuffed into deaf ears and is applied to scalds and burns, and is also introduced into the urethra in stricture. The Chinese also use a poultice of the boiled leaves for dispersing tumours, and apply them in the same form to the breasts of a nursing mother to induce the secretion of milk. This lastnamed application of the leaves is not however confined to the Chinese doctors, but is known to practitioners among more civilised people; such a poultice kept on for from 12 to 24 hours being stated to be infallible in bringing milk after childbirth. The leaves applied in the same way to the abdomen will promote menstrual discharge. They have been found useful also as a local application in rheumatism. The dyers are said by some authorities to use castor-oil seeds in some way which gives permanency to their colours.

Among other uses in America, castor oil is used by the leather dressers, who claim for it that it will neither dry nor gum.

The bark of the root is a powerful purgative, and Colonel Drury says that when made into a ball the size of a lime, in conjunction with chillies and tobacco-leaves, it is an excellent remedy for gripes in a horse.

Adulteration.—Castor oil is often adulterated with common fixed oils; and sometimes croton oil is added to restore or to increase the purgative properties. Good expressed oil is nearly inodorous and insipid; viscid, transparent, and colourless, or of a very pale straw colour.

Dr. Bancroft, among other important lights which he has thrown upon botany—both scientific and economic—has succeeded, by crossing the white variety, which casts its seeds too quickly, and the red, that is so difficult to husk, in producing a good shelling variety, seeds of which can, I have no doubt, be procured from him. A Nottingham man, of the name of Livesey, made some oil in Brisbane, but I believe abandoned the industry from want of means. Dr. Bancroft is of the opinion, in which I concur, that as soon as anyone is found with the capital and skill for an oil mill, there will be no difficulty in persuading the farmers to grow the raw product from which to manufacture the oil, the value of which as a lubricator, apart altogether from its uses in medicine, will always secure for it a steady demand.

CHICORY.

(*Cichorium Intybus.*—COMPOSITÆ.)

This plant in its wild state has a very wide range. It is a hardy perennial, and is found on the road sides, on the borders of fields, and in waste places over the greater part of Europe and Asia, being limited, indeed only by the arctic regions and by the tropics. Like many other plants which are intrinsically handsome, but which when common are disregarded, the really beautiful blue flowers of the Chicory (some often upon a stem 5 feet high) are not to be found in our gardens, although they would compare successfully with many of the rarer beauties of the flower border.

While, however, thought unworthy of a place in our ornamental gardens, Chicory plays no unimportant part in our domestic economy and in the industries of the world. As a salad the young leaves are largely used in France and Belgium and in other parts of Europe, but are not so frequently seen on English tables. By the Chinese, who are perhaps the best vegetable gardeners in the world, it is used largely. Although somewhat bitter, this salad is very wholesome, and is much liked by all who have accustomed themselves to it.

The seed is sown in drills about 16 inches apart, and when the young plants appear it is necessary to sow a little quick-lime over them as a preventative against snails and slugs, which are very apt to attack the tender crop of leaves. Before the leaves cover the ground the plants are thinned out, and the intervals between the rows forked over and kept free from weeds. The plant has a thick white fleshy taproot, and thrives in any soil the quality, depth, and condition of which would suit the carrot. In from five to six months the roots are taken up and stored. In England the weight of crop ranges from 3 to 5 tons per acre ; but the American reports give 15 tons as the average. This latter estimate is probably either a mistake or an overstatement. In the very early stages of the crop the young leaves are sometimes gathered and used for salad ; but this is made principally from blanched leaves forced more or less in the dark, by various methods after the roots have been taken up and stored. From the store of roots from time to time a sufficient quantity is taken and placed in sand in a warm dark cellar, where new leaves, perfectly colourless and tender, are produced. Another method, specially adapted for providing salads on long voyages, consists in boring holes in a board in rows four inches apart, and filling it up with alternate layers of sand and roots, with the tops of the plants protruding through the holes. The barrel being placed in darkness and warmth, the plants make

new leaves, affording a continuous supply of the most delicious material for salad, the slightly bitter flavour being once got over. The blanched leaves obtained by this, or other slightly modified processes on the same principle, constitute the *Barbe de Capucin* ("Capuchin's Beard") of the French.

There are in cultivation several varieties of the Chicory—one especially of late years, originally raised in Belgium, and which has found its way to and become a favourite in America, is known as "whitloof," meaning "white-leaf," which forms a very close head similar to that of a Cos lettuce. It is also called the "large-rooted Brussels Chicory," from its thick, stubby root, which is said to be the most profitable variety cultivated for admixture with coffee. In Brussels the leafy heads of the "whitloof" are cooked whole and eaten with cream sauce, and in this mode are much esteemed as a vegetable dish for the dinner table. It is equally good as a winter salad, its blanched leaves being less bitter than those of the ordinary Chicory. The young roots also, boiled like a parsnip, are palatable eating as a vegetable.

The herbage of Chicory is excellent food for sheep and cattle, and the plant is often cultivated for this purpose. As feed it is at its best just before coming into flower.

The chief commercial use of Chicory is in the form of the dried, roasted, and powdered root as a substitute for or adulterant of coffee. To prepare it for this purpose, the root is first cut into small pieces, dried in a kiln, and then roasted in revolving iron cylinders. The loss between the weight of the fresh and that of the roasted root is from 25 to 30 per cent. During the roasting, 2 lbs. of lard to every cwt. of Chicory is added to give it a lustre like that of coffee. The powder looks very like ground coffee, and has a strong odour of liquorice.

An extract of Chicory, obtained by a patent process, has lately appeared in Germany for use as a substitute for or addition to coffee; the residue of the root, after extraction of the essence, making a good food for cattle.

No slight difference of opinion exists as to the real value of Chicory as a beverage. Its admixture with coffee is said to, and no doubt does, diminish the exciting effects of the latter, but the same result would be produced by taking the coffee weaker, or less of it. In Belgium, Holland, and Germany, it is much used in a pure state as a substitute for coffee, but as among its known medicinal qualities it acts both upon the kidneys and bowels, its strength as a beverage must be much modified to fit it for use. Pereira, writing in 1853, sums up the case well in the following words, viz.:—

"Roasted chicory has been in use as a substitute for coffee for more than eighty years, and at the present time is extensively employed for adulterating coffee. It is, however, devoid of that fine aromatic flavour for which coffee is so much admired. By some persons it is said to be both wholesome and nutritive, by others it is declared to be neither one nor the other. The fact is that no obvious ill effects are usually observed by the use of chicorised coffee; but there can be no doubt that roasted chicory must, when taken largely, have a tendency to excite diarrhœa. It scarcely deserves to be called nutritive, since, with the exception of sugar, it is almost entirely devoid of nutritive principles."

The superiority of French over English coffee is attributed to the observing of careful proportions in the admixture of chicory and coffee, and to a particular variety of the former being used. The presence of chicory can be easily discovered both by chemical means and through the microscope; but the only really safe way of securing pure coffee is to purchase it in the form of the raw bean, and both to roast and grind it at home.

That the adulterant is itself adulterated will surprise few in this age of fraud and pretence. Chicory is imitated and weakened by a perfect host of rubbish—such as roasted peas, beans, lupins, rye, wheat—often all damaged; roots of various kinds, oak bark, logwood, mahogany dust, acorns, chesnuts, coffee husks, burnt sugar, dog biscuit, and even with the baked livers of bullocks and horses. These subadulterations can be all more or less readily detected, but it is unnecessary here to describe the methods used.

The medicinal properties of Chicory resemble those of the dandelion (*taraxicum*). The root acts upon the kidneys, and is gently tonic without being irritating, and is mildly aperient. In the form of a decoction it is employed in chronic visceral and cutaneous diseases.

CINNAMON.

(*Cinnamomum verum.*—LAURACEÆ.)

This tree, from which is derived a staple product of no mean importance in the commerce of the world, and so familiar in our every-day life, is a native of many warm countries, and has been introduced and is cultivated in others. It is indigenous to Ceylon, Malabar, Cochin China, Sumatra, Java, and many parts of India, while it is cultivated in those countries, as well as in Brazil, Mexico, and other parts of the South American continent. There are many species of the tree, but they are very close to each other, and have not yet been properly distinguished by botanists. The differences consist in size and form of leaves, height of trees, and colour of the bark; but it is thought probable that climate has something to do with these distinctions. In any case the matter is not of sufficient importance to dwell upon here; especially as the cinnamon plants brought to Queensland came from the far-famed cinnamon gardens of Ceylon, the country which of all others produces the best and highest priced bark which reaches the markets of the world. The matter is of less importance, also, from the fact that there is no difference whatever discoverable in the medicinal qualities of the bark of different species, the degree in which the aromatic principle is present constituting the sole distinction.

The Cinnamon grows to a height of from 20 to 30 feet, as the soil and situation may be favourable or otherwise. The trunk is slender and short, with wide-spreading branches; the leaves, which are bright green, and strongly-nerved, being in opposite pairs on a short footstalk. The young leaves are of a bright red colour, gradually changing to a light and again to a dark green. The insignificant white flowers are in clusters at the end of a long stalk. The bark is smooth and ash-coloured. The fruit consists of an oval pulpy berry, of a blue colour when ripe, containing a single seed, very like a small olive. The seed germinates soon after falling, and is very difficult to transport about the world. The importations made to this country have invariably been in the form of seedling plants in wardian cases. As many hundreds of plants have been distributed among the gardens of the coast lands, it is probable that we have the material already from which to form experimental plantations.

The quality of the soil is a most important feature in the cultivation of Cinnamon; a dry sandy soil, which would be inimical to the successful growth of most trees, being an essential condition of success in this case. Not only is the general growth of the tree beneficially influenced by a siliceous soil, but the quality and early maturity of the bark produced under these conditions is superior to that of trees grown in a hard, stiff, or

wet soil. Grown under favourable conditions, the trees can be made to yield their first product in five years ; but in wet or heavy soils, or in shaded situations, not only are the trees longer in maturing, but the quality of the bark is never so good.

Cinnamon is extensively planted upon nearly worn-out coffee estates and upon other lands considered to be unpromising for more favourite kinds of cultivation, and the results are said to be satisfactory.

In Ceylon Cinnamon is always grown in clumps or coppices, some of the stools being of great age. The shoots are not cut when less than from half to three-quarters of an inch in diameter, and those are selected which are tender and young, and promise to peel easily—the bark from such shoots being more valuable than from older wood. I abridge from many sources of information the following, as being the best and most reliable description of the method of cultivation :—"When the ground is prepared for planting cinnamon, the brushwood and young trees are cut down, but lofty tress are allowed to remain at intervals, as it is found that the young plants thrive better under their shade than when wholly exposed to the rays of the sun. The sowing takes place when the seeds are ripe. A foot square of ground is turned up at intervals of six or seven feet. The ashes of the clearing having been spread on the newly-dug spots, four or five cinnamon berries are dibbled into each. These are then covered up and protected with brushwood, both to prevent the surface from parching and to shade the young plants. Sometimes the berries are sown in nurseries and transplanted as soon as fit, in suitable weather. The seeds germinate in from fifteen to twenty days. Under favourable conditions the first shoots may be cut at about the sixth year, when a healthy bush will afford two or three shoots for peeling ; from four to seven shoots may be cut from one bush every second year. As four or five seeds are usually sown in one spot, and in most seasons the greater part germinate, the plants grow in clusters not unlike the hazel bush. If the season be unusually dry, many of the seeds fail, while the want of moisture is fatal to the young plants, so that it is often necessary to plant a piece of ground several times successively ; with intelligence and care the Queensland planter will have little difficulty, in his early experiments with cinnamon, in preventing failure from these causes. The plant is also propagated from cuttings and from layers ; both methods resulting in earlier bearing of the plants than in the case of seedlings. Great facilities are afforded by the coppice system of growing, for increasing by means of layers, the numerous side shoots near the ground affording abundant material for layering. When old stems are cut down close, and a fire kindled on the stumps, the roots afterwards throw out a number of long straight shoots, which are said to yield incomparably fine cinnamon ; such shoots make the cinnamon walking sticks, which always retain the taste and smell of cinnamon.

The shoots being cut are tied in bundles and carried off to sheds for preparation. Being cleared of small shoots and leaves two longitudinal slits are made in the bark, which is gradually loosened with the convex side of the knife, and then, usually half the circumference of the bark comes off in one entire slip. When the bark adheres firmly to the wood it is strongly rubbed with the handle of the peeling knife until it is disengaged and stripped off. The sections of the bark thus obtained are carefully put one into the other, the outer side of one piece being placed in contact with the inner side of another ; they are then collected into bundles and firmly pressed or bound together.

In this state the bark is allowed to remain for twenty-four hours, or sometimes for a longer period, by which means a degree of fermentation is induced that facilitates the subsequent operation of removing the cuticle. After being subjected to this treatment the interior side of each section of

bark is placed on a convex piece of wood, and the epidermis, together with the greenish pulpy matter immediately under it, is carefully scraped off with a curved knife. This is an operation requiring some nicety, for if any of the outer bark be allowed to remain it gives an unpleasant bitterness to the cinnamon. In a few hours after the removal of the cuticle, the pieces are put one into the other, the bark dries, contracts, and gradually acquires the appearance of a quill or pipe, the whole forming a congeries of quills more than a foot in length. During the first day the cinnamon is suspended under shelter upon open platforms, and on the second day it is placed on wicker work shelves and exposed to the sun. When sufficiently dry it is made up into bundles of about thirty pounds weight each, and these are deposited monthly in the Government magazine of Colombo, where, previous to preparing them for shipment, they undergo an examination by experienced native sorters under the superintendence of a European appointed for the purpose.

The bark of large shoots or thick branches of trees produce coarse cinnamon. Occasionally the external pellicle of this sort is scraped off, which thins the cinnamon and improves its colour. It is, however, even then, thicker and of a darker colour than that of a good quality, while it is of a very inferior flavour, and is disagreeably pungent. This sort is always rejected by the inspectors as unfit to be exported to Europe. The bark of very young and succulent shoots is likewise of an inferior quality, and is not admitted among the bales. It is hardly possible to discover the cause which produces the varieties in the quality of the bark, since shoots from the same tree are found to yield cinnamon of very different qualities.

The best Ceylon cinnamon is thin, smooth, and shining, and of a light-yellow colour; it is of about the substance of thick paper, admits of a considerable degree of pressure, and bends before it breaks, the fracture being splintery. It has an agreeable, warm, aromatic flavour, with a slight degree of sweetness. When masticated the pieces become soft, and seem to melt in the mouth, leaving no after-taste. Whatever is hard, thick, dark-coloured, or excessively hot in the mouth, should be rejected.

From cinnamon which has been rejected for shipment, and also from the leaves, fruit, and root-bark, a volatile oil, varying in character, is extracted; the best oil of cinnamon sinks in water, and is powerful enough to blister the tongue; but when inferior it is of lower specific gravity. A very large quantity of bark is required for obtaining only a small portion of oil; it is reckoned that 80 lbs. of newly-prepared cinnamon yield about 5½ ozs. of heavy oil, and 2½ ozs. of light oil.

It is the usual custom to send black pepper among the bales; this practice originated with the thrifty Dutch, since by filling up the interstices between the circular packages with pepper corns, tonnage was economised. If there were no pepper coffee was substituted. Thunberg attributes peculiarly excellent effects to this method of packing with pepper.

The bark, however, is not the sole product of the cinnamon-tree; excellent camphor is distilled from the roots; a substance called "cinnamon suet," or "cinnamon wax," is also obtained by bruising the ripe fruit and boiling it in water. The oily substance which floats on the water is removed, and when cooled becomes the article referred to, and is used as an ingredient for candles, which thus prepared give out in burning a delicious odour. The wood is light, fibrous, and inodorous; but from old trunks resinous knots are obtained, which work up beautifully in furniture making.

"Cassia buds" of commerce are the unexpanded flowers of the true Cinnamon, although their designation seems to point to them as a product of *Cinnamomum Cassia.* They are of a dark-brown colour, resembling a nail with a round head, being surrounded with a six-sided calyx, which gradually terminates to a point.

So valuable a product as Cinnamon cannot, of course, be expected to escape adulteration. This is chiefly accomplished by the substitution of the bark of another member of the same family, described in a former article. Some of the outer bark of the true species also finds its way into consumption; and this form and the bark of *Cinnamomum Cassia,* both weakened by previous distillation, are frequently used as adulterants.

Ground Cinnamon is much more easily and frequently adulterated. In some cases it consists entirely of Cassia, and in others arrowroot and potato flour are found, as well as wheat-flour and sago meal, baked so as to make the resemblance closer.

CITRONELLA, or LEMON GRASS.

(*Andropogon Schœnanthus.*—GRAMINACEÆ.)

Although this is not an uncommon plant in our gardens, its uses are very little known. The delicious perfume of its leaves often now obtains a place for it among our ornamental plants; and it may perhaps be more extensively grown when the fact that an essential oil of no slight industrial importance is extracted easily by the distillation of the leaves. In Ceylon and the Moluccas it is largely cultivated for its oil under the name of "Lemon Grass Oil," which is also exported from Bombay, Madras, the Malabar Coast, and elsewhere in the East. The chief use to which the oil is put is in the preparing of soap, and also of fresh grease for the re-extraction of the perfume in the form of an essence by means of the "Enfleurage" process. In this latter form, as well as in that of the oil, it is much passed into use as "Essence," or "Oil," of "Verbena."

In both the East and West Indies a tea is made with the fresh leaves which is considered to be a good stomachic and tonic as well as being useful in dyspepsia. The decoction also has a mild sudorific effect. The Javanese constantly use it as an aromatic and stimulant. The decoction of the leaves as well as of the root makes a pleasant and cooling drink in fevers, and has been found very beneficial in nervous headaches. Bruised and mixed with butter-milk the leaves are used in cases of ringworm. The oil is a most valuable remedy, externally applied, in rheumatism, neuralgia, sprains, &c.; but its virtues are still more apparent in affections of the bowels. In cholera it allays and arrests vomiting, the dose being from 12 to 20 drops of the double distilled oil taken on a lump of sugar, repeated until the symptoms abate, the oil being at the same time applied externally to the lips, back, and stomach. The roots and flowers have similar qualities.

For culinary purposes the leaves are used to flavour custards, and the pithy white centre of the leaves is used for a similar purpose in curries.

When first distilled the oil is of a high colour, owing to the resin which it contains, and in this stage it is known in commerce as "Lemon Grass Oil." By re-distillation with charcoal it becomes clear and is passed into consumption under the designation "Citronelle."

Andropogon Schœnanthus is a native of India, Arabia, and Ceylon. In Bengal large tracts of waste land are covered with it. This is not the only species containing an essential oil of similar character, but is the one most cultivated for its extraction; all the species are, however, of the easiest cultivation.

Both leaves and roots may be dried and be kept for a long time without losing their virtue. In former times they were brought to England from Turkey in bundles about a foot long, and kept in the druggists' shops as a stomachic and deobstruent.

It is almost needless to add that that Citronella oil is frequently adulterated.

COCA-LEAF.

(*Erythroxylon Coca.*—ERYTHROXYLEÆ.)

This is a shrub growing from 6 to 8 feet high, somewhat resembling the tea shrub. It is found on the Andes of Peru in the Cinchona regions from 2,000 to 9,000 feet above the sea level. Like tobacco and tea it is used wholly for the virtues contained in its leaves, to the masticating of which the Indians are greatly addicted. Whatever justification there is for the cultivation and use of tobacco and opium, applies still more in the case of the Coca, which, when used in moderation, is attended with distinctly beneficial results. It is a powerful stimulant of the nervous system, affecting it in a manner analogous to that of opium, but is less violent and more lasting in its action. There is so much concurrent testimony as to place beyond doubt the fact that the moderate use of Coca-leaves as a masticatory enables fatigue to be endured with less distress and with less nourishment. Markham says that he chewed Coca very frequently, and, besides the agreeable soothing feeling it produced, he found that he could endure long abstinence from food with less inconvenience than he would otherwise have felt; and it enabled him to ascend precipitous mountain sides with a feeling of lightness and elasticity, and without losing breath. To the Peruvian Indian the Coca is a solace which affords great enjoyment, and has a most beneficial effect.

Von Tschudi, speaking of its virtues, says, that setting aside all extravagant and visionary notions on the subject, he is clearly of opinion that the moderate use of Coca is not merely innoxious, but that it may even be conducive to health. In support of this conclusion he refers to the numerous examples of longevity among Indians who, almost from boyhood, have been in the habit of masticating Coca three times a day, and nevertheless enjoy perfect health. That the Coca is in the highest degree nutritious is a fact beyond dispute. The incredible fatigue, says Von Tschudi, endured by the Peruvian Infantry with very spare diet, but with the regular use of Coca, and the laborious toils of the Indian miner kept up under similar circumstances throughout a long series of years, certainly afford sufficient ground for attributing to the Coca leaves not a quality of mere temporary stimulus, but a powerful nutritive principle. In proof, he instances cases which came under his own observation of laborious work done, and long journeys made, under the support of literally nothing but periodical chews of Coca-leaves. The practice is not confined to the labouring classes or the Peruvian Indians alone—Indians, whites, negroes, and various admixtures of blood, all use Coca; but among the higher grades it is done in private. There are even societies, having Englishmen among their members, which meet at regular intervals in the evening to enjoy a chew of Coca.

The excessive use of Coca, however, like that of any other stimulant, is undoubtedly injurious, and after a series of years wears out mental vigour and activity, although when used in the utmost excess it never causes a total alienation of the mental powers, nor does it induce sleep. An inveterate Coca chewer is known at the first glance: his unsteady gait, his yellow-coloured skin, his dim and sunken eyes, his quivering lips, and general apathy, all bear evidence of the baneful effects of the Coca juice when taken in excess. The eye, also, seems unable to bear light, and there is a marked distention of the pupil. Nevertheless, Markham, who was a close observer, while admitting that, like everything else used to excess, it is prejudicial to health, yet is of opinion that of all the narcotics used by men, Coca is the least injurious and the most soothing and invigorating.

According to Poeppig, on the table-land the use of Coca is unattended with the evil consequences which arise from its use in warmer and damp districts; and we have something analogous to this in the different results arising from the use of ardent spirits in cold climates and in warm.

Von Tschudi says that the flavour of Coca is not unpleasant. It is slightly bitter, aromatic, and something similar to that of inferior green tea. When mixed with banana-root ashes it is somewhat piquant, and more pleasant to European palates than without that addition. The smell of the fresh-dried leaves in a mass is almost overpowering; but this result entirely goes when they are packed in sacks.

Analysis has shown that an organic base exists in the leaves, analogous to caffaine in coffee and theine in tea, to which has been given the name of Cocaine.

The modes of using the leaf as a masticatory are various, each district appearing to have its own method. In some parts the leaves are charred in combination with Quinoa* seed, or with the pungent ashes of the same plant.

Others use clay or lime, which they first mix with the leaves and work the mass into little balls to be used as required. They keep each ball in the mouth as long as the taste remains bitter and fragrant, and then discard it. Others, again, mix with powdered chalk, or with the ashes of the banana-root. But the most curious method of chewing Coca is thus described by Von Tschudi:—Each Indian carries a leathern pouch and a small gourd. The pouch contains Coca leaves, and the gourd is filled with pulverised unslaked lime. Some of the leaves are masticated until they form a small ball. A thin slip of damp wood is then thrust into the gourd, and when drawn out some portion of the powdered lime adheres to it. The ball of masticated leaves, while still in the mouth, is punctured by this slip of wood until the lime mixing with the Coca gives it a proper relish; and the abundant flow of saliva thus excited is partly expectorated and partly swallowed. The application of the unslaked lime requires care, for if it comes into direct contact with the lips or gums, it causes a very painful burning.

The leaves are also not infrequently chewed by themselves, and on the Amazon they are dried in ovens, reduced to powder, mixed with the ashes of *Cecropia palmata*,† and formed into a cake.

Mueller states that the Peruvians mix the leaves with the forage of their mules to increase their power of enduring fatigue; but I do not find this statement supported by any of the authorities within my reach.

Coca leaf, while still on the shrub, is of a bright green, of a thin texture but opaque, oval in shape, and strongly marked with veins, of which two, in addition to the midrib, run parallel to the margin. The blossoms are white, and these are followed by small scarlet berries.‡ At the commencement of the rainy season the seeds are sown on the surface of well-shaded beds, which are kept watered. In about a fortnight they come up, and when sufficiently strong to permit of their being handled with safety, they are transplanted to spots specially prepared for them, generally on the mountain slopes, where the soil has to be kept up by small stone walls. They are generally placed in square holes about a foot deep lined with stones. Three or four are placed in each hole, and allowed to grow up together. These methods are traditionary; and, in modern days, plantations have been made on level

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* *Chenopodium quinoa* is a shrub cultivated in Peru or Chili for the sake of its seeds, which are in various ways used as an article of food. They abound in starch, but have a bitterish taste which makes them unpalatable to persons unaccustomed to their use. There are two kinds, viz., the white Quinoa, the seeds of which are used as food; and the red Quinoa, the seeds of which are used in various ways, both inwardly and outwardly, as medicine.

† A tree from 35 to 40 feet high belonging to a genus of soft-wooded milky trees of the nettle family.

‡ There are two kinds of the shrub; the only specific difference appearing to be in the size of the leaf.

ground, in which case the plants are set in furrows. At the end of about 18 months the leaves yield their first harvest, and continue to yield for 40 years. There is more than one picking in the year, and it is done with the greatest care to prevent injury to the tender shoots. This care is in some districts carried to the extent of cutting through the stem of each leaf by means of the finger nails. The fitness of the leaves for gathering is evidenced by their becoming rigid, and cracking when bent—size or colour are not regarded. With sufficient rain, or plentiful watering, forty days suffice to cover the plants with leaves afresh. The green leaves are opened out in thin layers in yards prepared for the purpose, and are dried in the sun. This process requires care, in order that the leaves may not become damp, as in that case they acquire a dark colour which affects their quality and, consequently, their market value. On the other hand, too much sun causes them to dry up and impairs their flavour. Artificial heat is rarely applied, as it is thought to diminish the strength of the leaves.

Coca leaf is of a perishable nature, and cannot be kept in stock for any considerable length of time. Its average duration in a sound state, on the coast, is about five months, after which time it is said to lose its flavour, and is regarded by the Indians as worthless.

The commerce in Coca being confined to South America, there are no reliable statistics available as to its extent. Markham, writing in 1862, and using the best information he could procure in his travels, estimates the annual yield throughout South America at thirty million pounds weight. The price fluctuates between 27s. and 36s. for the "tambor" of 50 lbs.; but a medium price of 30s. gives an annual value of no less than £900,000 for this staple product.

Bearing in mind the vast consumption of alcohol and tobacco in this colony as stimulants, and that that part of the population of South America who use Coca for the same purpose are long-lived and capable of enduring extraordinary fatigues by its aid, it is fairly worth considering whether we might not with advantage substitute this pure herb for the impure and often dangerously adulterated compounds in the form of alcoholic liquors and tobacco, which we so largely consume. *Erythroxylon Coca* has been several times introduced into this colony, but has not been distributed. I have no doubt that if it were enquired for from the two public Gardens in Brisbane, it could be without difficulty introduced in quantity.

COCOA.

(*Theobroma Cacao.*—BYTTNERIACEÆ.)

This tree, the fruit of which is the basis of the Cocoas and Chocolates in their numerous forms, which we drink as a beverage or eat as a sweetmeat, is a native of the continent and of many of the adjacent islands of Tropical America. The principal part of the Cocoa of commerce comes, however, from cultivated trees both in those countries where it is indigenous, as well as in Mauritius, Bourbon, Ceylon, and other parts of the tropics where it has been introduced. It flourishes best between the 17th parallels; but as it has been cultivated with success as far as the 25th, there is good reason to suppose that under favourable conditions a home may be found for it in Queensland. The tree will adapt itself up to an elevation of not far short of 2,000 feet.

The generic name "Theobroma" is composed of two Greek words meaning "food for the gods," and was given by Linnæus in token of the appreciation in which he held the beverage prepared from the nuts.

That tastes differed, however, in the early days of our knowledge of Cocoa, is evidenced by one Spanish traveller describing the drink as more fit for a pig than for man. "Cocoa" is the Mexican name for the tree; and "Chocolate" had its origin in the Mexican word "Chocolalt," which is stated to be derived from the noise made by crushing the beans between two stones.

The Cocoa is a handsomely-formed evergreen tree of from 12 to 16 feet in height, with an upright stem of some 6 feet before the branches begin to spread; the bark is smooth and of a cinnamon-brown colour, deepening with age. The bright green flowery leaves are oblong, lance-shaped, from 9 to 16 inches long, and 3 to 4 wide on a leaf stalk of 1 inch. The flowers are plentiful, small, of reddish colour, but without perfume—springing directly from the lower sides of the larger branches, and from the trunk itself, and have been known to emerge even from the root when left uncovered. Most of the flowers fall without fructifying, and there is seldom more than one fruit from each cluster of flowers. The wood is white, porous, and light, but capable of a high polish. The fruit varies a good deal in size and colour according to variety. It is an oblong ovate capsule, pointed at one end, deeply furrowed, longitudinally, from 6 to 10 inches long, and from 3 to 5 wide at the broadest part. Specimens of the fruit may be seen in the Queensland Museum. In colour, the ripe fruits vary from a delicate yellow to a purple. The rind is about ½ an inch thick, somewhat tough, and flesh-coloured within. Inside, the fruit is divided into 5 compartments, each containing from 5 to 10 flesh-coloured nuts embedded in a gelatinous white pulp, of the consistence of butter, sweet with a slightly acid flavour.

In Brazil a refreshing drink is made from the pulp as well as a delicious amber jelly, which, if it ever reached foreign markets, would rival guava jelly. This pulp separates from the rind of the ripe fruit, adhering to it only by filaments which penetrate it and reach the seeds, so that the seeds rattle inside when the capsule is mature and fit for gathering. The seeds vary in size, shape, and quality; in appearance being like an almond, but thicker. The pulp may be easily separated into as many parts as there are seeds, to which it adheres strongly; and they are wrapped up in it so that each seed seems to have its own proper pulp. They lose their vitality very soon when removed from the capsule, but preserve it for a considerable time if left in. Leaves, flowers, and fruit in various stages are to be seen on the tree all the year round, but the fruit is regularly harvested twice a year only.

The *Theobroma Cacao* is a deep-rooting tree, requiring a rich soil, and loose to a considerable depth. It seems to thrive better and to arrive at maturity earlier on low moist alluvial plains, but by no means objects to higher ground if the condition be present of sufficient depth of soil. Shelter from high and cold winds, and shade while in a young state, are essentials to successful growth. This latter is provided by planting a row of bananas, or of a species of coral-tree (*Erythrina umbrosa* or *E. velutina*), between every two rows of Cacao. These nursing mothers to be of service must, of course, have attained some growth before the young trees are planted. A breakwind of natural trees or of a hedge on the exposed side of the plantation is of great value where the formation does not provide the necessary protection.

The methods of forming plantations vary in unimportant particulars in different countries. Sometimes the plants are raised in nursery and transplanted in about three months time, when they are 15 to 18 inches high, in

straight rows, quincunx form 15 or 16 inches apart, or less, if the soil is not very fertile. The holes into which the young trees are transplanted should be deep enough to prevent the tap-root from being bent.

Where the plantation—as is more frequently the case—is made without the preliminary nursery work, the following method, with more or less of variation in detail, is followed :—When the land is ready some of the finest fruits are selected, the nuts taken out and thrown into a vessel of water. Those that swim are rejected, and the others are cleaned of their pulp and kept moist till they show signs of sprouting. Holes are then made about 16 feet apart, 12 inches in diameter and 6 inches deep, on one side of which a banana leaf is placed upright and the hole is again filled in. The seeds are then set, in a perpendicular position, three in a hole, triangularly, 2 inches below the surface ; after which the banana leaf is folded down as a shade from the sun and kept in its place by a stone. In about ten days the young plants appear, when the leaf is removed, and any temporary rustic protection from the sun is substituted. One plant only, and that the strongest, is allowed to remain in each hole.

The sowing is done in the rainy season ; and after the plants appear, should the weather be at all dry they must be mulched and watered. In two years the plants will be about 5 feet high and will begin to flower, but the blossoms are pulled off. In the fourth year a moderate crop is allowed to mature, after which the trees bear as they will, attaining full bearing in the eighth or tenth year, and continuing prolific for forty years.

During the first and second year low crops, such as sweet potatoes and cucumbers, are grown between the trees, both for economy and to keep down weeds and mulch the soil. The practice is, however, of doubtful utility and should be indulged with care, or may do more harm than good.

Until there are fruiting trees in Queensland, it will be useful to mention that cuttings will grow in sand, although not very freely.

The produce varies a good deal according to the conditions under which the trees are growing. In rich moist deep soils, where the trees are not crowded, as high a return as 11 lbs. of nuts per tree is obtained ; but under less favourable circumstances the yield falls off to as low an average sometimes as 1 lb.

Porter says that when cocoa-trees have once attained their full growth and come into productive bearing, there are but few objects of cultivation which call for fewer cares or less labour, in proportion to the extent of the produce obtained. A French writer, alluding to this subject, says :—" The planter may thenceforth enjoy in peace the possession which he has created. The trunks, deprived of their branches to the height of eight or ten feet, allow the eye to wander in all directions through the plantation. Interminable vistas present delightful points of perspective, and prepare for their rich possessor a temperature always refreshing. It is difficult," adds this lively writer, " to imagine any man happier than a Cacao planter when his estate has arrived at this condition. He has nothing more to do than to walk through his property, casting about him the eye of a master examining into the healthiness of his trees, and remarking if water has been applied to them in the proper degree."

It has been said above, that although the fruit ripens more or less all the year round, there are two principal harvests. The fruits are gathered as they ripen by means of a long forked stick. The test of ripeness is partly the colour, and, when within reach for observation, the rattling of the seeds inside the pod.

In some places, where the growers do not aim at the highest market value, the pods are opened and the seeds removed, cleaned, and dried, without any other preparation. The best kinds, however, have undergone a certain amount of fermentation, produced by the presence of the pulp, before being subjected to the action of the sun as a final process to fit them for packing. The fermentation has to be carefully watched that it does not proceed beyond a certain point, as upon the curing depends much of the flavour and keeping qualities of the bean. By some growers the entire fruit is thrown into heaps, and the fermentation is permitted to take place before the seeds are removed and dried, but the superior and more common method is to remove the seeds first. Even where this is done the method of inducing fermentation differs. Some simply throw the nuts into a heap, occasionally stirring them until they are considered ready for drying. By another process the nuts are placed in holes, covered with sand and stirred at intervals, fresh sand being added until all the moisture is absorbed. If the fermentation is too violent the batch is spoiled. Care must also be taken that the fruit is of equal ripeness. The unripe seeds have a bitter flavour which the curing does not remove, and the presence of a small number of green seeds will depreciate the quality of a whole crop. There is no rule as to the period of fermentation, which is governed by the state of the atmosphere, the variety of the fruit, and sundry minor conditions. The sun-drying must be so conducted as to avoid all risk of wetting by showers.

When in bearing state, Cocoa-trees are subject to a disease in the form of black spots or blotches on the bark. These should be carefully cut out as they appear. The dry nuts are also very subject to insect attacks.

The outside of the fruit after the seeds are removed is not without value, as after they have been dried they can be burnt and produce a residuum from which a strong brown soap is made.

At one time the nuts of the Cocoa were in common use in Mexico as coin; but since the coinage of the country has included smaller denominations this practice has gradually fallen into disuse.

"As a nutritive," says Hassall, "Cocoa stands very much higher than either coffee or tea, in consequence of the large quantities of fat, starch, and gluten contained in it. To secure the full advantage of the nutritious elements of Cocoa, it must be taken in the form of some of the higher class preparations which permit of the assimilation of the fat, &c., without disturbance of the digestion."

Analysers of Cocoa have strangely differed. The most reliable is that of our own great chemist, Dr. Lyon Playfair, and is as follows, viz.:—

	Parts.
Cocoa butter	50
Albuminoid substances	20
Starch, sugar, &c.	13
Salts	4
Theobromine	2
Other constituents	11
	100

Butter of Cocoa, apart from its nutritive qualities, is one of the most emollient substances known, and is employed as a cosmetic, and as a soothing application to sores and chaps. It is extracted from the beans either by boiling, or by subjecting the seeds to pressure after being steamed. They yield almost half their bulk in butter, which is at first a yellowish brown, but becomes white by purification. It is sweet to the taste, its fracture slightly granular, and touch unctuous.

The following table, given by Dr. John Holm, shows the relative composition of—

—	Cocoa.	Milk.	Meat (Beef).	Wheaten Flour.
Fat	50·0	3·5	2·87	1·2
Azotised substance	20·0	4·0	20·75	14·6
Starch	7·0	...	...	59·7
Gum	6·0	...	...	...
Sugar	...	4·3	...	7·2
Water	5·0	87·5	67·80	13·2
Salts	4·0	0·7	5·60	1·6
Woody fibre	4·0	...	...	...
Cellulose	...	...	...	1·7
Colouring matter	2·0	...	...	...
Ash	...	...	1·60	0·8
Extractive matters	...	...	1·38	...
Theobromine	2·0	...	...	...
Parts	100·0	100·0	100·00	100·0

"By this," says Holm, "it is apparent that in nutritive power Cocoa holds an entirely exceptional position. It combines in a high degree of concentration nearly all the elements necessary to man's existence. It is deficient in moisture, which renders it comparatively richer in both nitrogenous and non-nitrogenous elements than any of those with which it is compared.

"Thus, although one half of its weight consists of cocoa-butter, it still presents 20 per cent. of albuminoid material, as against 4 per cent. in milk, 20 75 in beef, and 14·6 in wheat. In addition, it contains starch, which is present neither in milk nor beef, but in smaller proportion than in wheat, of which it forms 59·7 per cent. Comparing cocoa with milk, we thus see that the former is richer in nitrogenous substances analogous to those contained in milk, and that the fat also exists in a considerably larger proportion. The same remark applies to beef, and it further contains valuable substances which they do not possess. In wheat the starch appears to hold the place that the butter takes in cocoa, otherwise their composition has great similarities; but cocoa has again the advantage of possessing qualities which the other has not. The value of cocoa as a food is thus apparent, and fully justifies the high eulogiums passed upon it by so many men eminent in science."

There are many varieties of cocoa, differing in form, appearance, and value, the produce of different countries, generally bearing in commerce the name of the country producing them. As an instance of the blunders into which writers, otherwise accurate, will permit themselves to fall, I may mention that among the cocoa-producing countries, named by a quite modern authority upon the subject, is "Australia"; but it is only fair to add that he qualifies the statement by saying that the yield is "quite unimportant." That Queensland may become a producer I have no doubt, and hope for its own sake that it may; but the first cocoa fruit has yet got to be produced in this or any other part of Australia.

When the seed is nearly ripe it is sometimes preserved in sugar, and makes a very delicious preserve.

Before proceeding to the methods of manufacture, I should refer to the fact that the seed has a husk of its own, which is of little value but is often used as an ingredient in the poor and fraudulent imitations of good prepared cocoas and chocolates. When this husk is removed the surface of the nut is seen to be marked with grooves dividing it into irregular portions. These depressions mark the course of the filaments to which I have referred before in describing the fruit, and they divide the cotyledons from each other, and each into several parts of irregular shape, which when broken up form the "cocoa-nibs" of commerce.

The methods of manufacture vary much; principally, it must be confessed to the shame of the age, in the effort of many of the makers to include in the article which they turn out a minimum of cocoa to a very large quantity indeed of foreign ingredients. The crude modes used by the natives of countries where the tree is indigenous are very simple. When the Spaniards first landed in America, the natives extracted the flavour and fat from the nuts with water, and mixed it with boiled maize-meal; and the result, coloured with anatto and flavoured with allspice, was made into cakes called "chocolalt," whence, as before mentioned, our own word. In the West Indies the nuts are slightly parched, when the husk easily separates from the bean. This latter is then ground up between two stones, or pounded into a paste in a mortar, coloured with a small quantity of anatto, and made up into rolls of about a pound each, in this state entering largely into domestic use.

There is no more difficulty in having pure cocoa than pure coffee in our households. Previous to being used the nuts are parched in an ordinary coffee roaster, when the husk readily separates and is sifted out. As in the case of coffee, the stage at which the roasting is sufficient is evidenced by the aroma. After parching, the beans are easily broken up into nibs, or still further reduced by grinding and pounding.

To give my readers a true idea of the principles involved in the honest manufacture of cocoa into its most nutritive and useful forms, I cannot do better than quote from John Holm, who, besides being a physician of some repute, was a partner in the well-known firm of Dunn and Hewett, who have made their name widely known as manufacturers of high-class cocoa.

"For many years," says Dr. Holme, "after the introduction of raw cocoa into England, its manufacture was conducted in a very rude manner, no attempt being made to separate the husk of the cocoa-nut from the nib. The mode of manufacture was to grind the whole bean with sugar and farinaceous substances. This was then either run into rude blocks and called rock cocoa, or cast into cakes or long rolls somewhat of the appearance of short rulers, and sold under the name of cake or roll cocoa. Gradually an advance was made in this rude method of manufacture, and in the preparation of what was called chocolate an endeavour was made to imitate the Spanish manufacturers. This led to the husks being carefully removed, and the ground nibs alone incorporated with sugar, or sugar and farina, in the manufacture of what was called chocolate. The mode adopted in the manufacture of chocolate was to roast the nuts, and when cool to break them down and separate the shell from the nibs. The nibs were then again subjected to a further roasting, and the extent to which this process was carried then gave the distinctive character to the chocolates produced in different parts of Europe. The cocoa nibs were now placed upon a heated smooth stone, and crushed with a roller until the nibs assumed the form of a smooth paste, which was then mixed with sugar, and sometimes some farinaceous substance. Various spices were also now incorporated according to the flavour desired; and the mass, when thoroughly mixed, was placed into moulds, where it remained until cool and ready to be turned out. Another form of

cocoa called flake was also much used, and this consisted only of the cocoa beans, shell, and nib crushed in a mill into the form of flakes. Notwithstanding the inherent value of the food, none of these productions, however, met with any great consumption. They were all expensive, but the finer cake chocolates were of so high a price as to be only obtainable by the wealthy. The cocoas besides being dear were also unpalatable, and, owing to the presence of the husk, very indigestible, and irritating to the internal mucous membranes. Both kinds, in addition, laboured under the disadvantage of requiring boiling.

"This drawback, which is common to all cocoas and chocolates of foreign manufacture, does not appear in Spain and France to have militated against their large consumption; but for some reason or other—whether it be that we do not as a nation like trouble where it can be avoided—the tedious and somewhat unpleasant process of first having to scrape and then boil the cake of chocolate, carefully stirring the while, and afterwards milling it, has never found favour; and this is one of the reasons that its use was so limited until the last fifty years. The removal of this drawback is due to Mr. Daniel Dunn. After a long series of experiments in relation to the treatment of cocoa, he found that by making a slight variation in the mode of the preparation and mixture of the sugar with the cocoa nibs, he was able to produce a substance in the form of paste, which only required the addition of boiling water to be ready for use. This cocoa or chocolate paste was the first form of soluble cocoa ever made. From the first he discarded, in his own preparations, the barbarism of grinding up the husk with the cocoa nib, a practice both wasteful and unwholesome. Having succeeded in producing, in the form of paste, a cocoa which did not need boiling, it was found that a serious drawback existed from the need of its being contained in earthenware pots or other vessels. These were not only inconvenient, but being expensive and heavy they added both to the cost of production and transit. Mr. Dunn therefore further pursued his experiments, and found that by varying his process so as to reduce the amount of moisture, he was enabled to bring the paste into a condition sufficiently hard to enable it to be cut; at the same time the soluble properties still being retained. The cakes had the disadvantage, however, of requiring to be scraped into the cup, a somewhat sticky process; and were also not very pleasing to the eye.

"Mr. Dunn, still pursuing his investigations, found that by adding some farinaceous substance (he preferred and only used arrowroot) he could bring the cocoa into the form of a powder, which was more readily miscible even than his previous preparations. This form is the most convenient one in which cocoa can be prepared, and although, from the price usually paid, we are accustomed to preparations somewhat inferior in flavour to the finer French chocolates, there is no difficulty in making a soluble cocoa or chocolate powder quite equal in quality to them.

"The mode of manufacture of soluble cocoa or chocolate powder is as follows: The raw nuts are first picked in order to remove any mouldy or damaged nuts, the presence of which would injure the flavour of the cocoa. The picked nuts are then placed in revolving heated cylinders. When sufficiently roasted—a process which takes from three-quarters of an hour to an hour and a half—they are either spread out thinly on a grating or placed in coolers so constructed as to offer a large conducting surface, and are thus rapidly cooled down. The roasted nuts are then conveyed to a knibbling mill supplied with fans; the cocoa is here broken down and the shell winnowed from the nib. When this operation is fully effected, the nibs are slightly warmed before being ground.

"A cocoa mill constructed to reduce the nibs into a fine paste consists of two parts, viz., the feed mill and the grinding mill. The object of the feed mill is merely to regulate the supply of cocoa sent into the grinding mill. The latter is not unlike a flour mill, consisting of a horizontal bed on which revolves a runner.

"These mills have to be heated, and the cocoa runs from them in a smooth, semi-liquid condition, when it is ready for incorporation with the sugar and farinaceous substances with which it is to be mixed. It is afterwards reduced to a powder. This powder may be made either fine or coarse, it being a question of merely manipulative process which has no relation to quality. If required very fine it may have to be more completely pulverised in another mill. But whether coarse in grain or fine matters not; the cocoa is the same in quality—that is, either fine or common preparations may have either appearance. With slight variations of process, this is the only way in which soluble cocoa powder can be produced—that is, it must contain sugar and farina. The cocoa being in the first place very finely ground, the sugar causes it to mix readily, while the farinaceous substance holds the particles of cocoa in suspension, and the whole forms an emulsion.

"This mechanical suspension renders the particles of cocoa more digestible, and, keeping the globules of cocoa-butter in a finely divided condition, they also are more readily assimilated. Thus the farina, in addition to its important office in aiding in the production of powder, has another distinct advantage—it really causes the cocoa-butter to be in a similar condition as regards the cup of cocoa that the fat globules of milk are in before rising to the surface as cream. And it does not need any deep physiological knowledge to know that we can take in milk a considerable quantity of these fat globules without inconvenience, whereas the same amount taken in the more concentrated form of cream would often produce indigestion and biliousness.

"Some chemists have denied that this effect is produced in cocoa by the addition of farina; but by practical experiment I can vouch for the fact. The reason they have fallen into this error is by looking at the subject only from the chemist's view, and not from that of the practical physiologist, and assuming that such a result could only arise from a definite chemical action produced by the farina on the fat. This is not so; there is probably no such action; but by separating the particles of fat—that is, forming an emulsion—they are presented to the stomach in a form in which they can be readily assimilated.

"The present mode of making French chocolate in cakes differs somewhat from the mode of producing soluble cocoas. The nibs are placed in a heated mill called a *mélangeur*, formed of a revolving granite table, with two heavy granite runners. When brought to the consistency of a smooth paste, sugar or sugar and farina (as is the case in the cheaper qualities) are added, and the whole well ground and mixed together. When thoroughly incorporated, the mill is cleared and the partially prepared chocolate is passed between three horizontal rollers, which thoroughly crush any particles not previously sufficiently ground. This operation is repeated several times to bring the chocolate into a perfectly smooth condition; it is then again placed in the *mélangeur* to be finally mixed, when it is ready to be moulded into cakes or fancy forms, or to be used for covering the bonbons called chocolate creams. The mode of moulding the cakes is first to weigh the chocolate, which is then put into a number of moulds placed on a tray to receive it; it is then removed to a table, to which, by means of an

intermittent action, a strong vibratory motion is communicated and this shakes the chocolate well into the moulds, from which, when perfectly cool, the cakes can be turned out. A circumstance to be noted is that these are then in a highly electrical condition."

There are few articles of food which are made the subject of so many, and often of such nasty, adulterations. The nibs themselves are not to be trusted, being not infrequently mixed with fragments of roasted chicory. I dismiss arrowroot, sago-meal, and other wholesome farinaceous substances from the list of adulterants, on account of their useful mechanical effect in the making of soluble preparations; although, for the mere purpose of cheapening the cost of manufacture, these are beyond doubt more largely used than is necessary. In some so-called chocolates cocoa is not present at all, the roasted "ground-nut" forming the entire basis, and flavouring doing all the rest. The "ground-nut" is also largely used as an adulterant. The cheaper preparations commence with a basis of mere husks or of refuse cocoa beans, which are ground and admixed with chicory, foreign fats, the coarsest sugars, treacle, old biscuit, potato starch, &c., &c., while analysis has detected the presence of peroxide of iron, red lead, cinnabar, brick-dust, and red ochre. Hassall states that the animal fats used to supply the deficiency of cocoa-butter are generally tallow and often "greaves."

Before leaving the subject, I may add that the experiments on cocoa-growing, made by the most enterprising and far-seeing Government in the world in these matters—that of India—are being attended with success, trees having fruited on the Neilgherries. As a further evidence of the important changes which the acclimatisation and domestication of plants are making in the world, we have the case of Ceylon, where the cocoa is an introduced tree, not only a large producer, but the product of such excellence that in 1880 Ceylon cocoa topped the market.

THE COCO-NUT.

(*Cocos nucifera.*—PALMACEÆ.)

This tree, one of the most wonderful and also most valuable in the world, possesses peculiar interest for Queensland, as during the last ten years there has been abundant proof that it will thrive on many parts of our coast, and it only now remains for enterprise to include the products of the coco-nut tree among the staple commodities of the colony. As far back as the year 1869 the writer drew attention to this subject, and expressed the opinion, since verified by practical experience, that the cultivation of the coco-nut tree offered to settlers on our Northern coast more than one new industry. Having visited several of the coast settlements where the coco-nut has been planted with varying success, I attribute the rare cases of failure which were observable to want of knowledge of the requirements of the tree, and not to defects of climate or of soil, both of which are suitable if the localities for planting are well chosen.

The name *Cocos* belongs to a genus comprising more than twenty species, of which the subject of this article—*C. nucifera*—is beyond question the most important. The name seems to have had its origin in the circumstance that the three holes at the base of the fruit give it some likeness to the head of the Cocos or Coquin monkey, whence the Portuguese are said to have called the tree "Coqueiro." Tradition assigns the discovery of the tree in Ceylon to a divine manifestation made to a Cingalese Rajah,

who, following the miraculous instruction, travelled with his retinue to the coast, and there for the first time saw the wonderful tree which now plays so important a part in the social, domestic, and economic life of hundreds of thousands of the earth's inhabitants. The Rajah, who had suffered from a leprous infliction, was restored to perfect health by confining his diet to the simple and wholesome products of this tree; and thus this charming relic of traditionary lore, graphically told by Berthold Seemann, engrafts upon its main incidents, which teem with the marvellous and the romantic, the great lesson of the value of frugality and simplicity of diet in mitigating or curing many of the various phases of disease which form part of the heritage of man.

Grave doubts are entertained as to the native country of the coco-nut, but it is now found in every part of the Tropics either naturally or cultivated, the number of trees in existence being calculable by tens of millions. It thrives best within the immediate influence of the sea, a few feet above high-water mark, the roots being actually laved by the waves; but it is also found a hundred leagues from the coast. The tree is cultivated also at considerable distances from the coast in Ceylon and elsewhere; but when removed from the influence of the sea it bears later and less abundantly, and is not so robust in growth. The limits beyond the Tropics at which the Coco-nut Palm will thrive and be productive are not well ascertained, much depending upon local conditions of soil, etc. Even in the Tropics it will fail sometimes under conditions apparently similar to those under which it is found wild; but study of the habits of the tree, and knowledge of the principles which govern all cultivation, will soon help the Queensland colonist to determine whether the conditions essential to success with this valuable tree are present. There is no doubt that its original range has in other countries been greatly extended by cultivation; and the opinion I have formed of the prospects of the coco-nut in this part of the world is that it will find the southernmost limit of commercial productiveness at Port Mackay; where, however, experience has already proved that proper selection of soil is essential to success, and that where the limit of suitable climate is reached, care in cultivation and study of the habits of the tree become more than ever necessary.

In the Tropics and in the immediate vicinity of the sea the Coco-nut Palm attains a height of from 60 to 100 feet; but as it recedes inland or beyond the tropical limits it diminishes in size. The trunk is cylindrical and is crowned with a number of waving feathery leaves, producing a splendid effect. There are no spines about the tree to render difficult the gathering of its products. The flower stems appear in the axils of the lower leaves, being enclosed in a thick tough spathe, and when fully expanded are milky white. It is from these flower spathes, before the flowers have expanded, that is drawn the juice to be converted into palm wine, toddy, or jaggery, as hereafter referred to. Under favourable conditions the tree blossoms five or six times in the year, and it is common to see flowers, and fruit of various sizes, at the same time. All the varieties contain a single nut enclosed within a fibrous husk, but there is considerable difference in the thickness of the husk, and the shape and size of the fruit.

Varieties.—Bennett speaks of six distinct varieties at Tahiti, and in Ceylon there are at least five, varying in size from the large King coco-nut, spherical in form and of a bright orange colour, down to a dwarf species the fruit of which is no larger than a turkey's egg. From Siam the Queensland Acclimatisation Society imported some nuts which differed remarkably in size and form; some being quite round and as large as a man's head, and others as oval as an emu's egg, and not much larger. Another and much

larger importation from Singapore comprised several varieties differing in form in marked degree, while the entire batch were incomparably superior in size to the fruit commonly imported from the islands of the Pacific. Of one species, of a pale yellow colour, and heart-shaped, it is said that the inner rind, next the shell, is edible.

Soil.—The Coco-nut Palm, though most frequently found or cultivated near the sea, is not necessarily littoral in its habit. But while proximity to the sea is not essential, there can be no question that the palm thrives better so situated; and in countries where it is largely cultivated for the staple commodities which are its products, it forms an item in the calculations of profit that the first harvest is not reaped so soon by several years in the inland as on the coast plantations. The reasons for the preference given by this tree for proximity to the sea appear to be :—

1. The soil best suited to its growth is sandy, porous, loose, and friable, though not necessarily poor. On the contrary, subject to the condition of thorough permeability, the soil may with advantage be rich; and, where practicable, should be made so if naturally deficient. 2. Salt, in a greater or less degree, is necessary, not to bare existence, but for perfect health and to ensure early maturity and robust growth. Salt appears to operate mechanically in arresting and maintaining moisture, as well as in supplying the tree with soda, which is one of the principal salts extracted from the earth by the tree. 3. A saline atmosphere appears to be beneficial, although not indispensable.

But though this preference for the sandy beach, and the superiority of the palms found or grown in such situations is indisputable, yet the fact of the coco-nut being generally found on the coast is, in some measure at least, to be attributed to another feature in the natural history of this wonderful tree. As I have said, authorities differ as to the original habitat of the Coco Palm, but there can be no doubt that it is found abundantly in places where it is certainly not indigenous, but where the nuts have been washed ashore from other countries. The mature fruit, with its water-tight and extremely buoyant husk, drops from the palm, and is carried out to sea by receding high tides. Many, doubtless, are tossed about till they eventually perish, but thousands are washed ashore, and upon genial soil germinate under the heat of the sun; in due course the trees which they form dropping nuts into the sea, and so reproduction goes on.

In selecting land for plantations, the conditions of porosity and moisture of soil, together with perfect drainage, are carefully regarded; while the fondness of the palm for salt is artificially met by the application of common salt, or by periodical dressings of the land with seaweed and saline mud, especially in the early stages of growth. In suitable soil, and if abundantly watered, the tree will fruit in its fourth or fifth year, and will produce from 9 to 12 clusters of flowers in the year.

Although the tree will bear the washing of water, whether salt or fresh, to their very stems, the water must not be stagnant. The writer recently observed, at one of our coast settlements, a remarkable instance of the value of water in developing the Coco Palm. Round a small garden had been planted some 20 trees. They were all in bearing, and formed a beautiful feature of the garden, as well as being a small source of profit to the owner. One of the number, however, was in close proximity to a well, and its roots had found their way to the water ; the result being that the tree was at least a third taller than any of the rest, its trunk thicker, the crown of leaves more numerous, longer and more dense, while the crop of fruit upon this individual was at least three times as heavy as that of any of its neighbours.

The cultivation of the coco-nut is in material points much the same in all countries where it is grown. In the following account I adhere chiefly to the system given by Porter, who is one of the safest authorities to follow upon tropical agriculture; amplifying where required, and supplying information upon points on which he is silent.

The nuts for sowing should be selected from a vigorous tree and a good producer, and should be large, ripe, sound, dark-coloured, and spherical, with little husk. Avoid long and pointed nuts, as they produce more husk than kernel. The fruit for sowing is not divested of its husk, as this in combination with water is necessary to induce germination. The best time for sowing is the Spring. The nut is laid longitudinally with a slight inclination so that the eye from which the germ issues may be presented towards the surface of the soil, and thus allow the shoot to rise perpendicularly from the ground. The nuts are placed in shallow holes and covered with a few inches of light soil, sand, seaweed, or soft mud, and are watered daily until they germinate. No material should be used which is apt to run too closely together, as any solidification of the soil at this stage should be carefully avoided. Within twenty days of sowing the white smooth point of the germ may be seen issuing from the earth, retaining the same form for two or three weeks. The first leaf is not developed until the thirty-fifth or fortieth day. It appears like a bundle of small ribbons shaded with pale flesh colour and bordered with a band of beautiful green. The roots first form in the fibrous husk, and about a month after sowing are sufficiently strong to burst the solid hard shell. About the third month they penetrate deep into the earth, where they take a very firm hold. As the plant increases in growth the roots spread so deep and firm in the earth that a coco-nut tree withstands with rare exceptions the most violent storms. At the end of the fifth month the young leaves make their full appearance, but the leaflets are still adherent and united, as if the whole were cemented together. This appearance continues with all the new leaves which shoot out until the twelfth month. All the foliage issues from the crown of the stem, and is supported by a fibrous tissue of great strength, which is put to various uses in the domestic economy of the half or wholly barbarous races who depend so largely upon this tree. The time of transplanting varies among different people from six to fifteen months; but after the plants are substantially rooted the sooner they are transplanted the better. This is done into holes 20 to 30 feet apart, every care being taken to disturb the roots as little as possible. To induce the formation of new roots and secure to the young trees a firm hold upon the ground, every encouragement is given by mixing with the soil in the holes wood-ashes, well-rotted manure, soft mud or seaweed, and by some a thick stratum of salt is put in the bottom of the hole. Care must be taken to transplant the tree with all its roots and with as large a ball as possible. It should be planted exactly perpendicular, as it would maintain in its subsequent growth any incline given to it. The soil should be carefully and firmly replaced and be thoroughly watered. It is best to shade the young trees for a few weeks in some rough manner, but this is not universally done. Any wash of the soil baring the surface roots should be carefully replaced; and to prevent this, as well as to keep these roots cool and moist, mulching is very advantageous. Watering, which is beneficial to the coconut-tree at all ages, is essential—and that, too, abundantly—for a year or two after making a new plantation. The Hindoos make the tree the author of an adage—"Water me continually during my youth, and I will quench thy thirst abundantly during the whole course of my life." Every alternate year the young trees should be dressed with seaweed or salt manure; and if the conditions generally have been favourable the first flower stalk may be looked for at the end of the fifth year.

Fruit.—The appearance of the coco-nut and the ordinary uses of the fruit are so well known to man, woman, and child in all civilised countries that it is unnecessary to dwell upon them. Some authorities speak of no fewer than 30 varieties, chiefly distinguishable by their fruit; but it is more than probable that cultivation and incidental causes lead to apparent distinctions which are not real. Fruitfulness increases up to 50 or 60 years of age; but after that it falls off, although under favourable conditions the tree will attain a maximum age of 100 years. Several bunches of fruit are produced annually, each giving from 12 to 20 nuts. In the West Indies 100 nuts a tree is considered a good average, although exceptional trees sometimes produce double that number. The fruit takes about twelve months to mature; but many young nuts get blighted by dry and scorching winds, and fall off. It often happens also that after long dry weather, unless the trees have been systematically irrigated, the fruit does not set on the flower stems. While the fruit is young, and the albumen is still soft enough to be eaten with a spoon, it is very delicious. The so-called "milk"—that is, the albumen in a liquid state—of the young nut is cool and refreshing, and in moderate quantities is wholesome, but affects the kidneys if taken to excess. In Ceylon it is used for its adhesive properties as an ingredient in whitewash. It is also said that some of the best and purest castor oil is made by boiling the beans in a mixture of water and coco-nut milk.

Products.—(1.) *Oil.* The oil extracted from the fresh nut is far superior to the product of the dried kernel. It is obtained by boiling the fresh kernel for a short time in water, pounding and pressing. The emulsion or "milk," as it is technically called, thus obtained is again boiled over a slow fire, when the oil floats to the top and is skimmed off. This oil, when fresh, is of excellent flavour, and is used in cookery, for perfumery, and other fine purposes; two quarts of oil being obtained in this way from about 15 nuts. By another method the nut is grated and exposed to the sun in hollow vessels, when a first product of oil is obtained by exudation. A second draft, but not of such good quality, is then obtained by pressure. By a third process the kernels, broken out of the shell, are placed on shelves of split bamboo and subjected to the action of charcoal fire, and subsequently to the sun until dry, and then pressed. I describe these more homely methods before coming to "Copra," which is the main source of supply of the coco-nut oil of commerce. Copra is the name given to the ripe kernel after it has been exposed to the sun until all the watery particles are evaporated and the oily portion alone remains. In preparing this staple, ripe nuts only are used, and it is considered a good practice to allow the nuts themselves to dry for some weeks before breaking them and extracting the kernel.

The raw material, in the form of Copra, for the manufacture of oil, forms an important item in the export trade of the South Sea Islands, German enterprise being largely engaged in it. The oil from this source soon becames rancid. The term "oil" is in some respect a misnomer, inasmuch as the product at any temperature below 70 degrees Fahrenheit is a white solid. It consists of two distinct materials—a solid fat and a liquid fat—which are separated by hydraulic pressure; the solid stearine making a very valuable ingredient in the manufacture of candles, while the liquid oil is set free for various purposes of burning, perfumery, &c., for which it is used. It is not necessary to describe here the machinery used for extracting on a large scale the oil from copra; but it may be useful to state—my authority being Simmonds—that the machinery for the purpose, with all appliances, including a 10-horse power engine, packing, and delivery in London, costs about £1,354. Great quantities of oil are made in Ceylon

and other parts of India, the Brazilian coast, Siam, and the islands of the Indian and Pacific Oceans; and from some of these countries it is largely exported. Coco-nut oil burns with a clear bright flame, giving out neither smoke nor smell, and is readily consumable in open glass vessels, with floating or standing wicks, whatever the temperature of the air may be. Candles made from it are very superior, the light which they give being brilliant, the flame colourless, while the wick never fouls. It is also a well-known ingredient in the superior kinds of soap. The statements as to the yield of oil are somewhat conflicting, but in setting it down at 60 per cent. from properly-dried copra, I am rather within the mark.

The oilcake, which in India is called "Poonac," is excellent feed for pigs and poultry; but to the intelligent cultivator is of more value still to return as manure to his trees, thereby restoring some valuable component parts which they have extracted for the formation of fruit. The coconut-tree extracts from the soil chiefly silex and soda, and the presence of these two salts is essential for its successful cultivation.

Husk.—From the husk is produced the well known coir or coco-nut fibre, the quality of which differs much according to the method of preparation. By the early process the husks were steeped in salt or brackish water for 12 to 18 months, but modern experience shows that a very much shorter time will suffice, and that clear running water produces a brighter fibre. The separation of the pulp which holds the fibres together is effected by beating and working them, drying and beating again. The finer the fibre the greater its value; the colour should be a bright yellow. Although enormous quantities are produced by hand labour, machinery is coming into rapid use for the extraction of the fibre after the soaking process. Simmonds gives the cost of the machinery of a breaking-down mill, exclusive of soaking tanks, which can be made of wood or brick and cement, at £858 10s., delivered in London; but in factories where they extract the oil from the nut as well as the fibre from the husk, economy can be exercised by substituting a 14-horse power engine for the 10-horse power engine in the estimate given for the oil machinery, and making it do the work of the two processes. Such a machine can turn out 32 to 35 cwt. of long fibre, and 8 cwt. of brush fibre per day of 10 hours.

As to the yield of fibre, having no experience yet in Queensland, it is necessary to fall back on the statements of different authorities. There is, however, in these so much discrepancy as to make it very difficult to arrive at a satisfactory conclusion. Taking 40 nuts as the basis of calculation, I find the yield variously stated by one generally accepted authority at six pounds, sixty pounds, and one hundred and forty pounds; but judging from a comparison of the bulk with the weight of the husk, the lesser weight of the three is not likely to be far wrong. The pith or pulp separated in cleaning the fibre used to be sheer refuse; but for some years past it has entered largely into various phases of horticultural art, and is now in constant and large request; the market value in London being about threepence a bushel.

As this phase of my subject has special interest for gardeners, I will dwell for a moment on the uses of "coco-nut fibre refuse." As a medium for lightening soils in making composts, it is the best possible substitute for "leaf-mould," an article which in this dry climate it is very difficult to procure, and it makes an excellent medium for plunging potted plants. It is also largely and most successfully used for propagating purposes. It harbours no vermin, nor is it subject to fungus. When procurable in sufficient quantity, it adds greatly to the fertility of garden soils, and improves the texture of both sands and clays. The facility with which cuttings, plants, and bulbs root into it is really surprising. The writer has had not a little

personal experience in the use of this material, and is quite satisfied that no gardener who has once tested its virtues will ever be willing to do without it. It can be readily procured from the Fiji plantations.

The durability, elasticity, and strength of coir adapt it for an immense number of uses, of which perhaps the most important is its manufacture into cordage of all kinds, from mere string up to ships' cables. It will not take tar, but its imperishability in salt water renders this of little importance. The qualities already referred to, together with lightness and buoyancy, fit coir rope peculiarly for much of the work of a ship, but it is not as easily handled as hempen rope. The other uses of this fibre throughout the world are enormous. The husks themselves make the best of scrubbing brushes and floor polishers. It is used as stuffing for bedding, couches, and saddles, for making brushes, mats, matting, and even hats and bonnets. The coarsest and short fibres have largely taken the place of bristles for strong brushes ; while the very finest and longest of the fibre is curled, dyed black, and largely intermixed with curled horsehair, from which it can hardly be distinguished by the unpractised eye. Its elasticity when properly prepared renders it indeed hardly, if at all, inferior to horsehair for upholsterers' work ; and its use, while not openly admitted as an adulterant, has had the effect of cheapening horsehair.

Recent experiments in France give rise to expectation that coir will come into considerable use as a paper material.

The hardness, imperishability, and susceptibility to polish, of the shell, lead to its use for an infinity of purposes, such as vases, baskets, and goblets elaborately carved, book-cases, and pipe-bowls, spoons, ladles, skimmers, lamps, beads, and other fancy articles. It converts also into a good lamp-black and dentifrice. The unbroken shell makes a capital drinking vessel by piercing the holes, filling the nut with salt water, and then burying until the albumen is decayed, when it easily works out. By using large nuts for this purpose and fitting plugs for the holes, the traveller can carry cool water enough in this way for a day's journey in his valise.

Wood.—Before the trees become old, the trunks contain a sweet edible pith which is agreeable to the taste. At this stage, and while still in full-bearing, the outer case of the trunk, which constitutes the timber of the coco-nut-tree, is used for fencing, rafters, laths, shingles, furniture, water-pipes, &c., but has not attained its full value. That of fully mature and aged trees becomes extremely hard, and is susceptible of a very fine polish ; the soft pith has then been converted into a mass of hard fibre easily separable and fit for various uses. In this state it is exported under the name of Porcupine wood, and for cabinet and other ornamental work is much in request. Towards the lower part of the trunk of old trees this outer case becomes so hard as to be flinty, and polishes so as to resemble agate. Among other native uses to which the wood is put is that of small canoes and the building of stockades, which are impenetrable to bullets.

Toddy, Arrack, and Jaggery.—Six months after the appearance of the first flower spathe, the tree may be tapped for its juice, which is extracted from the undeveloped flower spathes. When fresh drawn this is delicious and wholesome, but after fermentation it takes the name of "Toddy," is intoxicating to a slight extent, and cannot be used with such impunity. In this form it is also used as yeast. From "Toddy" is made by distillation the ardent spirit known as "Arrack," and vinegar is also a product from the same source. Before fermentation the juice is reduced in large quantities, by boiling, to a sort of honey form, or is still further evaporated until on cooling it crystallises into a kind of sugar called "Jaggery." This, mixed with lime, makes a strong and very durable cement capable of resisting heat

and of taking a fine polish. In the present young state of the coco-nut industry in Queensland, I abstain from lengthening my account of the tree by describing the methods of obtaining the juice and converting it into the several products referred to. It is questionable if, in a wholly British community, the tree will ever be put to these uses to any extent of commercial importance; and the *modus operandi* may well be left for describing to another generation.

Medicinal Uses.—A decoction made from pieces of the root boiled with dried ginger and sugar is administered in remittent and intermittent fevers; and mixed with fresh coco-nut oil is also used as a gargle. The expressed juice of the leaves mixed with the fresh oil is applied as a remedy for piles. From the bark is collected a gummy exudation used in the form of ointment in cutaneous diseases. The oil has the property of preserving, strengthening, and softening the hair and in restoring its growth after loss from fever; and the fresh milk is used by the ladies in the West Indies as a cosmetic wash for the face. Fresh toddy is recommended in India to persons suffering from habitual constipation, and in cases of consumption. The flowers contain a powerful astringent, and the expressed juice mixed with new milk and taken in regular doses gives relief in various debilitating diseases. The small green undeveloped fruits are also very astringent, and grated down, are employed in dysentery, and as an ingredient of an ointment used for tumours.

In the Antilles the coco-nut is a popular remedy for tapeworm. A coco-nut is opened, the meat removed and scraped and administered to the patient. Three hours afterwards a dose of castor oil is given, the success being stated as most complete.

Leaves.—The leaves of a well developed tree attain 18 to 20 feet in length, and are put to a number of uses such as roofing, floor matting, screens, baskets, etc.; and in Tahiti they take a part in religious ceremonies, being an emblem of authority. The "heart," or very young leaves before unfolding, of this palm, like that of some of our own indigenous species of this grand order, makes an excellent vegetable both cooked and raw. The old dried leaves and spathe are used as torches and for fuel, and from their ashes potash can be abundantly obtained. Combs, brooms, and other articles are made from their midribs. At the base of the petiole, or foot-stalk of the leaf, is a kind of network. This when very young is delicate, white, and transparent, but when mature becomes coarse and tough; and is used as strainers for toddy, arrowroot, coco-nut oil, etc., and to a certain extent as apparel.

Cookery.—The ripe kernel scraped and the white juice squeezed through a cloth is used, with or without the grated kernel, in curries, etc.; a sort of cheesecake is made from the kernel scraped or pared down; and it is also used to make a dish boiled with rice. Various preparations of confectionery contain the grated nut as an ingredient; among which coco-nut ice and candy will be familiar to our children. To the intelligent and inventive cook numerous other methods of utilising so tasty an article of food may suggest themselves.

Enemies.—Among these is a remarkable crab which lives wholly on the nut, for extracting the kernel of which it is furnished with very curious natural appliances. The tree has also various insect enemies, especially among the beetles. I prefer, however, not to overlay my present account of the tree by describing its enemies in other countries. As the tree increases in Queensland, it must be expected that injurious insects will be found to attack it. These, as they show themselves, will doubtless be made the subject of scientific and practical investigation, and their habits being determined, remedies will eventually follow.

In the "Journal of Applied Science" for 1878 reference is made to a "blight" which has afflicted the coco-nut palms in the island of St. Vincent, from which they have never recovered; and it is stated that now but few of these trees are in the island, notwithstanding many attempts at growing them. No authority for the statement is given, nor is the so called "blight" described; and, in the absence of anything in the history of the tree giving instances of extensive decadence and its causes, the statement has little weight.

Summary.—When it is remembered for how many purposes the coco-nut and its produce enter into the economy of life, and that the nuts imported into Europe are only the excess of those required for manufacture where they grow, or for the daily food and other purposes of millions of people, only a faint idea can be formed of the enormous produce of this tree, and of its importance to the human race. I repeat the points already urged upon Queensland colonists—

(1.) That there are many thousands of acres of our coast lands suitable for the cultivation of this invaluable tree.

(2.) That it is a tree easy of cultivation and highly profitable.

(3.) But that, like many other staples of agriculture, though profitable under conditions of intelligent cultivation and suitable soil and climate, it can no more be grown successfully without these conditions than can sugar, wheat, cotton, or any other crop.

(4.) That while some of its roots penetrate deep into the earth, some take a more horizontal direction under the surface; and that, therefore, mulching will materially contribute to successful cultivation.

(5.) That in the early stages of the tree's growth frequent waterings and shade from the excessive heat of the sun are essential.

(6.) That the tree insists upon a loose, friable, and if possible a moist soil; and that where the latter quality is wanting it must be supplied by irrigation.

(7.) That the application of salt when planting, and periodical dressings of saline manure, must not be neglected.

The subject of this article is very far from exhausted, but the foregoing will answer the writer's object, and fill the space available for this one out of the many subjects to be dealt with. He is tempted, however, to reproduce, by way of summary of the virtues of one of the most wonderful trees of the world, the following extract from a work of Louis Figuier, one of the most charming writers upon plants and their properties:—

"Imagine a traveller passing through one of these countries, situated under a burning sky, where coolness and shade are so rare, and where habitations in which to take the repose so necessary to the traveller are only to be found at considerable distances. Panting and dispirited, the poor traveller at length perceives a hut surrounded by some trees, with straight erect stems, surmounted by an immense tuft of green leaves, some being upright, and the others pendent, giving an elegant and agreeable aspect to the scene; nothing else near the cabin indicates cultivated land.

"At this sight the spirits of the traveller revive; he collects his strength and is soon beneath the hospitable roof. His host offers him a sourish drink, with which he slakes his thirst; it refreshes him. When he has taken some repose the Indian invites him to share his repast. He serves up various meats contained in a brown-looking vessel, smooth and glossy; he serves also some wine of an extremely agreeable flavour. Towards the end of the repast his host offers him certain succulent comforts, and he is made to taste some excellent spirits. The astonished traveller asks who in the desert country furnishes him with all these things. 'My coco-nut tree' is the reply. 'The water I presented you with on your arrival is drawn from

the fruit before it is ripe, and some of the nuts which contain it weigh three or four pounds. This almond, so delicate in its flavour, is the fruit when ripe. This milk which you find so agreeable is drawn from the nut. This cabbage, whose flavour is so delicate, is the top of the coco-nut; but we rarely regale ourselves with this delicacy, for the tree from which the cabbage is cut dies soon after. This wine with which you are so satisfied is still furnished by the coco-nut tree. In order to obtain it an incision is made into the *spathe* of the flowers; it flows from it in a white liquor, which is gathered in proper vessels, and we call it palm-wine; exposed to the sun it gets sour and turns to vinegar. By distillation we obtain this very good brandy which you have tasted. The sap has supplied the sugar with which these preserves are sweetened. These vessels and utensils have been made out of the shell of the nut. Nor is this all. This habitation itself I owe entirely to these invaluable trees; with their wood my cabin is constructed; their leaves, dried and plaited, form the roof; made into an umbrella they shelter me from the sun in my walks; the clothes which cover me are woven out of the filaments of their leaves. These mats, which serve so many useful purposes, proceed from them also. The sifter which you behold was found made to my hand in that part of the tree whence the leaves issue; with these same leaves woven together we can make sails for ships; the species of fibre that envelops the nut is much preferable to tow for caulking ships, it does not rot in the water, and it swells in imbibing it; it makes excellent string, and all sorts of cable and cordage. Finally, the delicate oil that has seasoned many of our meats, and that which burns in my lamp, is expressed from the fresh kernel.'

"The stranger would listen with astonishment to the poor Indian who, having only his coco-nut tree, had nearly everything which was necessary for his existence. When the traveller was disposed to take his departure his host again addressed him:—'I am about to write to a friend I have in the city; may I ask you to charge yourself with my communication?' 'Yes; but will your coco-nut tree still supply you with what you want?' 'Certainly,' said the Indian; 'with the saw-dust from severing the leaves I made this ink, and with the leaves this parchment. In former times it was used to record all public and memorable acts.'"

COFFEE.

(*Coffea Arabica.*—RUBIACEÆ.)

There are few vegetable staple products, the literature of which is so extensive as is the case with Coffee. Originally from the mountains of Abyssinia, the tree found its way to Arabia; thence introduced by the Dutch to Java it subsequently spread to the British, Spanish, and French West Indies, the East Indies, Ceylon, Venezuela, New Granada, Brazil, Cayenne, Surinam, &c. The conditions and methods of cultivation are naturally much modified by climate and national custom of the different countries producing coffee; and the space available for the subject of this article will therefore permit little more than a glance at its many phases and an outline of the principles underlying the production and preparation for market of this, one of the most important of food products.

The coffee-tree derives its name from Caffa, a province of its native country —Abyssinia. It is an evergreen, attaining a height of from 15 to 20 feet, although in Arabia it has been known to attain to 30 feet. It has an erect stem, a brownish bark, and opposite branches with an obliquely downward

tendency, which gives to the whole shrub an elegant pyramidal outline. The wood is of a yellowish colour, and so hard as to be suited for the engraver. The flowers, which are not unlike those of the white jasmine, are formed in clusters at the axis of the leaves. They are very pretty and highly fragrant, but last only a short time. Flowers are to be found nearly all the year round, but only in spring and autumn are they produced in considerable numbers. The flowers are followed by green oval berries, which crowd so much together often as to interfere with their simultaneous ripening, and to necessitate gathering by instalments. As they ripen they become red, attaining at maturity a deep scarlet colour, which presents a rich contrast to the dark green glossy leaves. The ripe fruit, in appearance not unlike a mulberry, but longer, consists of a soft external skin enclosing a sweetish, insipid, and somewhat glutinous pulp, covering two hard oval seeds about the size of an ordinary pea. One side of the seed is convex, the other flat, with a straight central longitudinal furrow. The flat sides of the seeds are towards each other, and the two seeds are covered with a tough membrane which, from its appearance, is technically known as the "parchment." The "raw coffee" of commerce consists of these seeds deprived of the pulp and parchment, and thoroughly dried. If one seed is abortive the other takes an oval round form, and these are known as "pea-berry" coffee. They seldom occur in young and vigorous trees, but are supposed to possess a superior flavour and to roast better, for which reasons, real or imaginary, they fetch a higher price in the market, although the difference is not so great as it used to be. Coffee in the husk or parchment is sometimes, but rarely, imported into England, and still more rarely the dried fruits, which consist of the berry sun-dried just as picked. The varieties of coffee are distinguished in commerce by the names of the countries or places producing them, and further, by certain technical descriptions, according to quality; and these distinctions are recognisable by experts from variations in colour, form, and size. There is an enormous difference in the value of coffee; even in the same crop of the same estate the earliest and best matured getting double the price of the later and imperfectly ripened berries. "Jackall" or "Monkey" coffee is the name given to what may generally be termed the sweepings, such as berries which have fallen, or have been knocked off the trees, or spilled by the pickers; green berries which will not ripen, and strays which dry on the trees; and also berries which have passed through the intestines of jackalls, monkeys, and other animals or birds.

The berries take about seven months from the flower to come to perfection, that is, for a first picking, which is generally a very limited one, as only a small proportion of the berries ripen at first. The gathering of these affords light, air, and room for the bulk crop to mature, and this is gathered about a month later. There are still left a considerable number of unripe berries, which are fit to gather in a few weeks after, the time varying with the weather. The gradual gathering of the crop, although necessitating going over the ground more often, is not without its advantage in affording more time for careful preparation for market.

That raw coffee improves by keeping does not appear to admit of doubt. It is even stated that, by storing in a dry place, the inferior kinds of American can be made to become equal to the best Turkey. This, however, is disputed, and growers will probably find it to their interest to produce the finest article in the first instance, by good cultivation and thorough preparation for market. It is more than doubtful among intelligent modern planters if climate or soil materially affect the quality of coffee, presuming that equal judgment in selecting locality has been used, and equal care given to cultivation and curing. Dr. Browne, in his "History of Jamaica,"

states that new coffee will never parch or mix well owing to the natural clamminess of the seed, which requires time to destroy; but this opinion is probably a remnant of the days of rough appliances, the more perfect modern machinery effectually cleaning the berry from its mucilaginous surroundings.

The coffee principle is known as *Caffeine*, and is identical with the *theine* extracted from China tea, and from Paraguay tea,—the *Maté* of South America,—and of Guarana, a stimulant and restorative consisting of the pounded seeds of a Brazilian plant, *Paullinia sorbilis*. Roasting develops the soluble principles of the berry, if carried up to a certain point; but if carried beyond that point, which has to be learned by experience, the process gradually destroys the principle, overroasted coffee possessing little more virtue than charcoal with a coffee smell.

Coffee berries have a remarkable disposition to imbibe exhalations from other things with which they come in contact, and are easily tainted by proximity in the ship's hold to pepper, sugar, rum, allspice, and other strongly scented products. They also lose colour unless packed as soon as the curing process is complete. For these reasons the process of packing and stowing for export largely influence the market results to the grower.

The best climate for the production of high-class coffees is found on the slopes of tropical mountains, commencing at an elevation of about 2,500 feet up to 4,500 feet above sea level. These limits vary somewhat in different places, being to a certain extent governed by local conditions. Coffees of the best quality are grown both higher and lower, 5,000 feet being the maximum. The average range of temperature during the summer months best suited to the cultivation is from 65° to 80° Fahr., and in the cool season from 55° to 72°; at 4,500 feet the last-named temperatures indicating the mean average variation throughout the year. At these elevations, where the climate is wholly congenial, any system of shading is not only unnecessary but injurious when the plants are once fairly rooted and growing. Coffee is, however, largely produced below 2,500 feet, down even to the level of the sea; but from 1,500 feet downwards the market value of the coffee produced rapidly lessens, fetching often a price fifty per cent. lower than the product of the more congenial regions. At the lower levels shade becomes indispensable, being provided either by leaving such of the original timber as is suitable, or by planting trees for the purpose. Coffee cannot, however, be treated by any fixed rule in all climates alike. Where the rain is pretty equally distributed over the year shade can be done without, but in climates subject to long periods of dry weather more or less of shade is indispensable. It is hardly necessary to insist upon the importance of aspect, and shelter from injurious winds, as coffee is not singular in demanding attention to these points, which more or less also determine the degree to which shade is necessary. Let anyone try the difference between an eastern and a western slope, and he will find the effects of the sun's rays and of drying winds, in heating the soil and parching the plant, difficult to believe but for ocular proof. But here, again, it must be remarked that there can be no fixed rule for a whole district. The contour of the country and liability of particular spots to draughts have much to do with the matter. Aspects which may be thought exposed are often untouched by the wind, while in others apparently sheltered it often rushes on with injurious effect.

In planting shade trees, the Jack tree (*Artocarpus integrifolia*) is about one of the best that can be used. The Coral tree (*Erythrina* sps.) already recommended for shading cocoa plantations, is also very suitable. Probably also the marvellously rapid growing *Phytolacca dioica*—the "Bella Sombra" of the Mediterranean—would prove a suitable tree. In any case, however,

soft-wooded trees should be used which grow quickly and are easily removed when no longer wanted, or if they show signs of interfering too much with the coffee trees. If the Jack tree is used the seed should be sown where the tree is to grow.

For coffee the rainfall should be moderately frequent and saturating, with intervals of six to ten weeks of dry weather. When the rain is more frequent or continuous, the crops are proportionately more scanty.

The plant thrives best in deep soils into which its taproot can easily penetrate without encountering clay or stagnant moisture. It particularly affects good and deep soil in among rocks, which prevent the soil from washing away in heavy rains. It insists more, however, upon a friable, deep, and thoroughly drained, than upon a very rich soil—indeed the soil may be too rich, and produce too luxuriant a growth. If the taproot is arrested the tree will not last long. In Arabia, where the droughts are long and excessive, periodical irrigation is resorted to.

It is impossible to fix any average of yield. The conditions of soil, aspect, climate, and season, as well as of cultivation and care in picking, are all elements in the amount of produce. From 4 cwt. per acre, which is a small crop, up to 12 cwt., which is unusually large, is the range in Ceylon. In Jamaica the average produce quoted to the writer by one of the best authorities, Dr. Robert Thompson, is from 5 to 8 cwt.

The plants are best obtained by raising in a nursery. This should be established in good, well-drained soil—if in the vicinity of water so much the better. The beds are formed of a convenient length and width, for perfect command in the various operations of watering, shading, or handling the plants, with proper walks between. It is better to water by means of channels between the beds, so that the water may percolate into the soil, than from overhead. The beds being well prepared, lines are drawn about 6 inches apart, and $1\frac{1}{2}$ inches deep, in which the seeds, which should be quite fresh from the pulp, and with the parchment left on, are sown about 1 inch apart. Other methods of obtaining plants and making nurseries are practised, but that given above is selected as the most systematic and certain in its results. In from one to two months the young plants will be strong enough to be pricked out into another part of the nursery prepared for the purpose, at a distance of 8 inches from each other. In about six months more the young plants will be about 12 inches high, and are ready for their permanent position in the plantation. The amount of shading and watering required depends much upon the season, and must be left to the judgment and intelligence of the planter.

While the plants are being grown in the nursery the plantation is being prepared for their reception, the best positions for coffee being the slopes of mountains, in soil interspersed with boulders of rock : tillage in the ordinary manner is never resorted to. The land is cleared either wholly or partially, as the planter may purpose using, or not, any of the natural timber for shade. In clearing it is better by far to leave as much of the timber as possible on the surface to rot than to burn it off, a process which hardens, and otherwise affects prejudicially, the surface soil; on the other hand, the fallen timber, in the process of decay, enriches the surface, and affords a protection to the young plants. If the planter intends to rely on shading by means of the standing trees, the number to be left will of course be regulated by the value of the exposure. If it is preferred to thoroughly clear the land before planting, a certain amount of natural growth always reappears, and such of this as is suitable may be left for shade to the young plants. I have dealt, under the head of "climate," with the subject of planting for shade. The land being ready, holes are dug at regular distances apart, the lines being made,

for symmetry and other reasons, to run all one way. The holes vary in size according much to the fancy of the planter, from 9 to 12 inches in diameter, and from 15 to 18 inches in depth. The distance apart has been the subject of much difference of opinion, but is necessarily, to some extent, governed by the quality of the soil. In Ceylon it is now almost invariably either

5 x 5 feet,	giving about	1740	trees to the acre,
5 x 6 „	„	1452	„ „ „
or 6 x 6 „	„	1210	„ „ „

Wider distances in Ceylon have been wholly discarded, but in Jamaica they still plant 7 by 7, having no doubt sufficient reasons of climate and soil for so doing.

I do not dwell upon any exact method of marking out the positions of the holes. There is no more mystery about this than in doing the same thing for an orchard. Coffee planting being done on a larger scale and on steep slopes requires care and intelligence to do the work well and without waste of labour; but the Queensland planter will no doubt be equal to the occasion. Nor is it needful to say anything special about the removal of the young plants from the nursery to the plantation. Suitable weather and all reasonable care is required.

The land should be quite ready for planting early in the spring. By these means a good start is got with all operations, and the plants have had time to renew their root action, after removal, before the sun gets too powerful.

There will of course be some misses among the plants first put out, and during suitable weather these vacancies must be from time to time filled in. In planting, care must be taken that the taproot is not bent or broken, and as much as is in the way should be neatly pruned off. Some planters, where they consider the nature of the soil permits, dibble in the plants without any previous preparation whatever of the soil; but the practice is not one which is at all to be commended, and does not deserve even the success which such a system rarely attains.

After planting, the only care required for the first few years is weeding, and this must by no means be neglected. In what way this is done will depend, of course, upon the class and amount of labour available, but the land must be kept clean, the weeds being either left in heaps, or, better still, buried. Coffee plants make rapid progress when this is carefully attended to and the shade properly regulated; and under favourable circumstances will yield a maiden crop in three years.

Plantations are occasionally formed by sowing the seeds where the plants are permanently to remain. Plants thus raised mature earlier and take a better hold of the ground. Several seeds are sown in each hole, and when the plants are a few inches high all are removed except the strongest.

Intercropping during the first and second year is to a certain extent practised, but by no means universally, and is not to be recommended. If done at all it should be confined to a single crop of upright habit like maize, which as a set-off against what it takes out of the ground will have shaded the young coffee plants and have helped to keep down the weeds; but the writer's experience of the temptations and dangers of intercropping induces him to advise that it be altogether avoided, and that the small advantages from a crop such as is above referred to be obtained by other means.

If time and money permit, the drains—which are an essential phase of a coffee plantation—should be made before planting; but if this cannot be managed it is better to wait until the young plants are at least 18 inches high, so that they may not be injured by the earth thrown out. There is

no rule as to distance apart, which will be regulated a good deal by the pitch of the land; and it may vary from 50 to 120 feet. The size varies also from 15 to 18 inches, according to the work which the drains may be called upon to do; and the gradient will also depend upon that of the land, being regulated so that the drains will keep themselves clear without being cut up by the too rapid flow of the water. It is a good plan to direct the water wherever, and as soon as, possible, out of the artificial drain into any natural ravine. In some cases the drains are directed into large pits, by which means the washed surface soil is saved and can be used as topdressing. The writer of the " Coffee Planters' Manual," published by the proprietors of the *Colombo Observer*, an authority which must be respected and may safely be followed, recommends holes about two feet square and one foot deep to collect the water and save wash. The greater the wash the more numerous should be the holes, which may be made thus between each two trees—

```
O       O       O       O
    □       □       □
O       O       O       O
    □       □       □
O       O       O       O
    □       □       □
```

In a dryer district where it is desired to catch the accumulated surface debris, so as to admit of the roots of the trees reaching the holes and feeding upon the fresh soil collected therein, the following method, which involves less labour, is recommended—

```
O     O     O     O     O
   □           □           □
O     O     O     O     O

O     O     O     O     O
   □           □           □
O     O     O     O     O
```

By the first method every four trees draw nourishment from five holes. By the second every four trees have a hole to themselves. "The latter," says the author, "is of course the more economical plan, while the former opens up the land better, and provides space for collecting more of the surface wealth of the soil which otherwise too often goes to waste. If your trees be old and their roots exposed you will do well to throw what you take out of the holes over the exposed roots. The loose earth about them and the cover thus provided from the blazing sun will serve as well as a manuring to the fields so treated, and when in course of time the soil washes back the holes are there to catch it again."

If all that has been written on the subject of pruning the coffee tree were collated, it would fill a large volume. The treatment of no tree in this respect has been the subject of so much difference of opinion; but there is probably no more mystery or difficulty about pruning the coffee-tree so as to induce it to bear a maximum of fruit, than in producing the same result from any other fruit tree. The same principles underly all pruning, and these are governed in their application by the natural form of the tree, in each

case, its special habit of making wood, its season of bearing, and the age of the fruit-bearing wood. During the period of least growth let light and air into the trees, and get them into a geometrical shape, pruning off all wiry looking or superfluous branches. A short experience will teach the grower which shoots will bear fruit and which will go to wood alone; and I prefer leaving him to find this for himself to giving a code of instructions about "primaries," "secondaries," and "tertiaries," or other technical jargon. Prune, however, from the first. It is very difficult to get trees into order which have been neglected, and these often only by the sacrifice of all crop for one entire year, and most careful attention to handling or rubbing off superfluous shoots during the growing season. This "handling" is in fact nothing more than every careful orchardist has to do to his trees, over and above the annual pruning while the sap is down, namely, to prevent the growth of superfluous branches by rubbing off young shoots which are not wanted, as they appear.

The topping of coffee trees so as to keep the crop within reach of the pickers is a speciality of the industry; but there is, again, much difference of opinion as to the best height at which to keep the trees. Ferguson's Manual for Ceylon gives 3 feet as a good average height, making the range from as low as 1½ foot in very poor soil up to a maximum of 3½ feet under the most favourable conditions. In Mysore the height varies from 3½ to 4 feet. In Jamaica, again, the highest ranges from 4 to 6 feet, beyond which maximum even they are sometimes allowed to grow. Topping must not be done until the wood is mature, which is evidenced by the bark turning brown; if the wood is cut green it is apt to die back.

Work of all kind among the trees is suspended when they are in flower, in order that the blossom may not be knocked off but be allowed to set into fruit. No material delay in the operations is occasioned by this necessity, as the blossom is short-lived and the danger of knocking it off is soon past.

Manuring forms a very important feature indeed of coffee planting. There has been a vast deal written upon the subject, and the number of natural and concentrated fertilisers, which have been made the subject of experiment, is legion. Farmyard manure where procurable is admittedly the best for the purpose, but its bulky character makes it difficult of application where the land is steep. Bones roughly broken or dissolved, superphosphates, lime, guano, wood-ashes, burnt clay, coffee pulp, bones disintegrated with coffee pulp, sheep-dung, nitrate of potash, and various patent manures are all good fertilisers; but the selection of a manure will of course depend upon the facilities for obtaining and applying it. The mode of application differs considerably according to the steepness of the land and the fancy of the planter. It is, however, quite needless to dwell upon this part of the subject to a class of men who have shown such large intelligence and skill as the agriculturists of Queensland. If the original forest was good and the soil rich vegetable mould, a plantation under shade will for some years be maintained in a sufficiently fertile state by annually digging into the ground the weeds and fallen leaves and twigs. Instances are cited of shaded estates from which as many as eight crops have been obtained before the soil showed any signs of exhaustion.

I have already stated that the berries do not all ripen together. The commonest and most approved method of obtaining the crop is to pick the berries from the trees; but in Arabia cloths are spread under the trees and the berries are shaken down. It is said that the perfection of coffee is obtained by allowing the berries to remain on the trees until they have shrivelled and are dry. In preparing for the market also, the berries are sometimes dried in the sun, as picked, and this method is asserted to produce

the best flavoured and heaviest coffee. Neither shaking from tall trees or drying in the pulp would answer for large production, and are not recommended. The berries when picked are carried at once to the pulping machine and separated from the outer pulp, after which they are immediately taken to the drying floor to be dried in the sun, being frequently raked over to secure rapid and effectual curing, which generally takes about 6 days. Every precaution must be taken to preserve the berries from rain, or dampness, during the process of curing. When *thoroughly* dried the berries go through another machine to remove the parchment, after which they are winnowed. When clean they are passed through another machine which sorts them into sizes. After this the berries are once more spread out; and broken, imperfect, and discoloured seeds are removed by hand. It is unnecessary to describe the several machines used in the preparation of coffee, as they are kept in stock where there is a demand for them and are as easily obtained as a plough or a corn-husker; nor do I advert to simpler and makeshift processes of curing adopted by small growers, as our pioneers in coffee-growing will have no difficulty in finding means of their own to get at the berry, until it becomes worth their while to purchase machines.

The enemies of the coffee-tree are many, and some of them are terribly destructive. I shall not dwell upon the insect foes, the "Borer," the "Grub," the "Fly," the "Black Bug," the "White Bug," or upon the "Rat," because it does not follow as a matter of course that these foes to the successful production of coffee will appear in this country. Should they do so, they are severally dealt with by the more exhaustive writers on coffee, and their natural history and the remedy against their ravages can be studied if required.

The case of the great fungoid destroyer, "*Hemileia vastatrix*" commonly known as the "leaf disease," stands somewhat differently. It is true that some years ago careful enquiry, made at the instigation of the Colonial Office, elicited the undoubted fact that among the coffee trees scattered about this colony this dreadful disease had not put in an appearance; nor is there the slightest reason to suppose that it has reached us yet. The germs of the disease are so subtle and so easily carried that we can, however, never feel safe from invasion by one of the most dire scourges that ever beset agricultural industry. This disease has been made the subject of exhaustive investigation by Mr. Morris, Professor Thiselton Dyer, of Kew, Mr. H. Marshall Ward, an eminent cryptogamist, and others; but its mode of attack, its history, means of mitigation and cure, are still the subject of much controversy. Professor Dyer describes the first appearance of the Hemileia as "indicated by a slight transparency or palish discolouration easily noticed when the leaf is held up to the light. These transparent spots indicate the points whence the infection of the leaf has begun. As the spot becomes larger and older it assumes a faint yellow colour; ultimately on the under side of the leaf it becomes covered with a bright yellow dust, and this later on changes to a bright orange. The discoloured patches are irregular in size, but always preserve a circular outline, except where, as occasionally happens, the accidental coalescence of two patches produces one of irregular form. They are most numerous towards the apex of the leaf, the tissue there being somewhat younger and more succulent, and therefore more easily attacked The centrifugal development of the patches is sometimes averted by the barrier presented by the midrib or a vein, but this is not always the case." Hemileia is in its turn sometimes attacked by some other fungus, and also by the larvæ of a small insect; but although an interesting fact, this does not appear in any way to affect the question of the

arresting the disease. As is commonly the case with fungoid disease in plants, the spores are carried by the wind, and the disease receives its most rapid development during warm weather.

There appears to be no doubt that in the case of "Hemileia," as with other corresponding diseases of plants, the plantations which are best cultivated, and which are under the most favourable conditions of soil, aspect, and drainage, enjoy the greatest immunity from the scourge.

Various remedies have been applied, but the cost and difficulty of application have rendered them practically useless. Two of these, however, appear to afford the most chance of being made effectual; both being based upon carbolic acid as the destructive agency of the fungus at different stages.

The first to notice is one discovered and advocated by Mr. Schrottky, a German chemist, whose system consists in the application of a preparation of carbolic acid in the form of powder to diseased trees, when the leaves are sufficiently moist with dew or otherwise to make the powder adherent. I cannot find the exact nature of the preparation, nor indeed am I aware if it has been disclosed; but experiments upon a large scale have been tried with it and with unquestionably valuable results. Already instances may be cited of the "Gangapitiya" plantation in Ceylon which had been specially treated with Schrottky's remedy. In December, 1881, this plantation was visited by a commission headed by the chairman of the Planters' Association, a highly intelligent and enterprising body of gentlemen associated especially in the interests of the coffee industry. Gangapitiya, surrounded by plantations showing abundant evidence of the presence of the disease, presented a marked difference from them, the trees looking healthy and luxuriant. It was only after considerable research that one tree here and there could be found at all, and then only immaterially, affected. In one portion which had not been treated for six months previously more disease was to be found, but even there it had to be looked for. No injury whatever from the powder could be seen even in the most tender leaf. The estate is one without special advantage of soil, situation, and manure, and had, for years before it was taken in hand by Mr. Schrottky, suffered severely from "leaf disease." It may be added that the remedy acts directly by contact with the fungus on the leaf, and not in any way through the roots.

The second method of cure is put forward by Mr. Jacob P. Storck, of Fiji, an old resident there, and an associate of the eminent botanist, Berthold Seemann. Having some personal knowledge of the great service done by Mr. Storck to the cause of Economic Botany, and of the earnest singleminded enthusiasm of the man as well as of his keen powers of observation, I give prominence to his remedy in his own words:—

"My own method of application," says Mr. Storck, writing from the Rewa River, on 25th November, 1881, "is purely atmospherical, and for the benefit of countries and planters suffering from the ravages of *Hemileia vastatrix*, I will now give a description of it. In doing this I rely, as regards my rights of priority and proprietorship in an invention of great importance, upon that spirit of justice and fairplay so generally obtaining in the scientific and planting world.

"An acre of coffee land contains thirty-six centres of vaporisation, formed by tin vessels to be mounted upon short sticks, and covered in a peculiar manner, to protect the contents from rain and rubbish, thereby preventing waste and undesirable dilution by rain of the fluid contents of the vessel. They consist of a mixture of carbolic acid and water, in the proportion of from 3 to 10 per cent. of Calvert's best No. 5 acid, at the option of the operator. Any strength not exceeding 25 per cent. may be used, since nothing touches the plants or the soil, nor injures the tenderest young leaf

or flower-bud. In starting the treatment, I would recommend a first charge of 10 per cent. (5 per cent. is sufficient), and then a weekly supply of a density of 5 per cent., which will keep the strength of the fluid up to 3 per cent. for many months. An average labourer can in this manner attend to at least fifty acres per week. The first season's outlay per acre, including the first establishment of the system over an estate, will not reach £2 10s. and for any subsequent year it will not exceed £1. The present model of the vessel has an evaporating surface of 4 inches, but I am contemplating an improvement in it, which will better regulate evaporation, and do away with weekly supplies, while a further reduction in the item of labour will be effected. The vessels, holding rather over half-a-pint, can be manufactured wholesale at 4d. each, and are so modelled as to allow of the closest packing, the two parts separately. They will last for many years.

"After eleven months of immunity from leaf disease enjoyed by the trees treated and cured by me, and of a new nursery I had made in the meantime, a gang of labourers from the upper river carried infection back to the place. Among the subjects infected were two Liberian coffee trees, one among a cluster of five, and another some short distance off in a small plantation of forty, all just in full spike, and to my dismay I also found the nursery badly infected. As soon as I could get the materials I started my system of vaporisation (July 4th last). The two Liberian trees I simply furnished with a small bottle each, partly filled with my mixture of only 3 per cent., hung into the angle of the lowest branches. Both trees have now been perfectly free of the fungus for some weeks, and not a single one of their close neighbours has been infected. They prove to have been completely isolated by the treatment, not a single spore living to reach and infect the others, although in some instances almost touching. With the nursery, covering about three quarters of an acre, I proceeded in the following manner :—Judging that with so small an area as the above I should be working at a disadvantage through the gas escaping beyond the limits of the area and going to waste in every direction, I arranged my centres of vaporisation a little closer than would be necessary on a large field, and put them eight yards apart each way. The receptacles of the fluid and their covers were represented by ordinary cups and saucers. Pressing the cups slightly into the ground and mounting the inverted saucers upon three or four short sticks stuck closely round the rim of the cups, I left a clear space of about one inch in depth between the rim of the cup and the cover. They were then charged with a dilution of 3 per cent., and the effects noticeable after a few days were most startling. The ripe spores with which the plants, then some nine months old, were fairly reeking, began to change colour from the well-known bright orange to a dull ochre, until they subsequently turned into dirty yellow and then greyish white. They all, instead of as usual dispersing, remained in a manner glued to the leaves, and afterwards dropped with them, dead, harmless, incapable of propagation. As the time went on, all rust which came out began to look dull in colour and sickly, quite different from a healthy crop of spores. By degrees pale rings round the rust patches began to shew, indicating the circumference of the mycelia, and where their further development had been arrested. In the third month a large proportion of the spots appeared pale green, whitish round the edges, and as if drying up in the middle ; some pushed out a few sickly spores, but very frequently none at all. The spots turned into dry tissue, and most of those leaves, unless too severely attacked, remained on the trees. Thenceforth a little dirty looking rust still continued to appear, but the presence of the disease up to its complete disappearance was chiefly indicated by dead and dying mycelia. From what I have witnessed, bare contact with the vaporised atmosphere seems, if not imme-

diately to kill the spores, to effectually incapacitate them for germination. From moving round in the nursery, examining the effects of the treatment as I frequently did, I would often go in among healthy trees, handle their leaves, pull suckers and the like, but not a single instance of further infection took place among those trees, Liberian and Arabian, which were healthy when the process was started. With grown trees, having leaves of denser texture and more uniform age than nursery plants, which are almost always growing, the effects, although apparently slower at the beginning, are in the end still more pronounced. They lose a greater proportion of leaves at the start, but all disease upon them and in them is dead before the fall, at once neutralising a fruitful source of reinfection. In the case of fairly vigorous trees, a new coat of clean foliage, never again to be soiled by the devastating parasite, will have formed by the time the last spore has disappeared.

"My method of permanent vaporisation is specially adapted for a country like Ceylon, for instance, when self-sown coffee in the forest and native garden patches presents a standing menace of re-infection which will defy any other treatment. With the permanent atmospherical treatment any spore of *Hemileia vastatrix* which comes in any way whatever within the radius of its influence must die. As I have asserted elsewhere:—'Anyone employing my process will reap the full benefit of his outlay, even though his neighbour's field next adjoining or just across the road may be reeking with disease for want of treatment. No live spore can be carried out of the area under treatment; nothing carried in can live, and re-infection becomes impossible.'

"For the guidance of any planters who may wish to give my system a trial I will here give the following directions:—Before my treatment comes into general use, so as to induce the wholesale manufacture of the specific tin vessel, planters will have to make shift, as I did, with cups and saucers, which must be so placed that they will not be overturned or buried by storm water coming down the hill-side, which contingency is avoided with the tin vessel mounted on a stick. Presuming the distances between the rows and in the rows of coffee-trees to be as usual (6 feet), commence at the corner of the field—say, working from right to left; start with the third tree in third row, then follow the base line, placing a vessel in every sixth row, between the third and fourth tree. When the base line is thus marked off start at right angles along the rows, count six, and place your vessels between the sixth and seventh trees in a line with the trees, so as not to obstruct work and passage; put down your cups, drive three or four short pegs immediately round the cups so as to steady them, and let the inverted saucer rest on the top of the pegs. They must be of even height, and long enough to allow the spout of a watering-pot or other feeding vessel to pass through under the roof, to save the trouble of lifting it every time, but they should not be so high as to allow rain and rubbish to be blown in; and then place a stone up to the size of a fist to make all more secure. This done you may go on charging your vessels with a density of at least 5 per cent., but, as I said above, I would for the first charge recommend a density of 10 per cent. The effects of the first week's dense vapour will amply repay the extra outlay in striking a death-blow not only against the rust in full development, but which is the greatest triumph of my system—against the mycelium of the fungus. This first blow will, under the circumstances, save a large proportion of the foliage, unless too far gone, by instantly arresting the development of the fungus, and killing all that may be still alive on the dead and dying leaves strewing the ground. If the disease is not visibly present all the better; the carbolic vapour will in a short time force it to show itself, chiefly in the character of dying mycelia, and save still more or

all of the foliage, which would have gone in the next attack of disease. The treatment may be started at any time with equal advantage. One week's ordinary weather will be found to evaporate about one-third of the contents of the cups, and thenceforth weekly supplies of 5 per cent. will be quite sufficient. Should at any time during a spell of wet cool weather so little water have evaporated (evaporation of the acid goes on continually), that there is not room in the cups to receive the ordinary quantity of diluted acid, raise the density to 15 per cent. or more, or only give a few drops of undiluted acid. All this is easily calculated, and must be left to the discretion of the operator.

"If planters are disinclined to make larger experiments, they may try my system with as few as ten acres, and they will soon see the contrast between them and the untreated portions of the field. One acre with another will only take thirty vessels. Six months after starting the process, those ten acres and a considerable margin all round will be in full foliage and crop, when the area outside the limit of effective vaporisation may be standing without a leaf, and the crop shrivelling and starving for want of shelter and food conductors. Choose your trial patch right in the centre of a good 100-acre field, and the experiment conducted with ordinary intelligence and regularity will in a few months convince the most sceptical of the value of my method.

"The chief merits of my method of permanent vaporisation may be summarised in the following:—

(1.) Undeniable simplicity.
(2.) Economy of material and labour.
(3.) The most perfect control.
(4.) Complete isolation of material from soil and plants.
(5.) Complete and unconditional immunity from leaf disease.

"I could bring the evidence of several neighbours who have witnessed the condition of the nursery and the few solitary trees, and the effects of my process, but as it could serve no practical purpose I abstain from doing so.

"Some months ago I applied to the Fijian Government for protection of my invention, and was refused on the strength of the reading of the local Patent Ordinance, which only partly covers the subject of my discovery, and only applies to inventions of a purely mechanical nature. My process has to be exhibited for many months in the open field, and cannot be kept under lock and key like a new machine, not to mention paltry matters patented every day. Therefore, I commend myself and my interests once more to the goodwill and love of justice of the public."

The art of roasting coffee requires much nicety, and can only be acquired, whether upon the larger scale for trade purposes, or upon the smaller for domestic use, by experience. It is done in a cylindrical iron vessel made to revolve on its axis over a clean fire. Up to a certain point the process of roasting has the effect of developing the fragrant and stimulating properties of the berry; but, that point once past, the effect of further heat is to dissipate or destroy those properties. The skilled coffee roaster can determine with accuracy by the sense of smell alone when the proper point has been reached; but the best test is that of colour, the experienced eye having no difficulty in deciding when the exact degree of brownness has been reached.

No beverage appears ever to have been so universal, or to have exercised so useful an influence over mankind as coffee. It is second indeed to no liquor in the universality of its use, and to those who become accustomed to it, it becomes almost as indispensable as in the case of addiction to spirituous or vinous liquors, with the incalculable superiority which it possesses over these latter in the fact that its use is beneficial instead of injurious.

The Persians are said to use the berry without divesting it of its parchment, with considerable improvement to the beverage, and also to use the parchment alone; and Bruce states that one of the wandering nations of Africa mix the wasted and pulverised coffee with a kind of butter, making the mixture into balls and conveying it in a bag. With this they can sustain strength and spirits for a whole day without food.

The *English Mechanic* gives the following recipe for the preparation of coffee in the Arabian fashion:—Roast some raw nibs and pound them down; when your water is boiling put in the coffee so treated and stir it about. Next place the pot again on the fire and carefully manipulate it if occasion requires, till simmering sets in, when you must immediately remove it and pour the contents into the cup. Milk or cream should never be added, but a little soft brown sugar may be used to suit the taste, also a little cardamom seed. Smoking a pipe of Turkish tobacco is only needed to give additional flavouring to your sips, and to transport you temporarily to the delights of the Moslem's paradise.

In Syria and Persia the beverage soon after its introduction became such a favourite among the people that the authorities attempted to check its use on the ground that the places of worship were deserted for coffee houses; but repressive measures were found to be wholly inefficacious, and the authorities wisely converted the growing national proclivity for coffee into a source of revenue, by exacting a license fee from its vendors.

"Taken in moderation," says a modern medical authority, "coffee is a mental and bodily stimulant of a most agreeable nature, and followed by no harmful reaction. It produces contentment of mind, allays bodily weakness and hunger, increases the incentive and capacity for work, makes man forget his misfortune, and enables those who use it to remain a long time without food or sleep, to endure unusual fatigue, and preserve their cheerfulness and contentment. The mental exhilaration, physical activity, and wakefulness it causes explain the fondness for it, which has been shown by so many men of science, poets, scholars, and others devoted to thinking. It has, indeed, been called 'the intellectual beverage.'" Medicinally it has value in intermittent fever, for headache, and as an aid to digestion. Coffee taken without milk after a hearty meal will relieve the sense of oppression so apt to be experienced, and will enable the stomach to perform its offices with comparative facility. It counteracts the effects of opium, and of the excessive use of tobacco, and affords relief from the after effects of intoxication. It is also used in diarrhœa, and in spasmodic asthma. Coffee cannot, however, be taken with equal effect by all persons alike, and in persons of a strongly nervous temperament it not unfrequently produces injurious results, proving too heating and exciting.

A learned French society has promulgated an opinion upon the combination of coffee with milk which is curious, because opposed to so much experience. The Société Impériale et Centrale d'Agriculture de France lays it down that, while black coffee is a stimulant and tonic promoting digestion after a meal, coffee and milk taken together constitute a composition absolutely indigestible. This is explained by the fact that the infusion of coffee is rich in tannin, and its mixture with milk has the result of converting the caseous part and albumen of the milk into a kind of leather, which resists the effect of the gastric juice and is wholly indigestible. The composition thus produced remains in the stomach until new aliments come to displace and force it through the lower orifice of the stomach into the intestines. The use of this mixture is sometimes attended with disagreeable results. Those who are not accustomed to it frequently undergo a purging through indigestion; and those who are, often eventually have inflammation of

the stomach, or one of the maladies to which this organ is subject, under the abuse thus put upon it. Women especially, from their delicate organisation, suffer in the consumption of coffee with milk. To dissuade from its use, says this learned body, it would be well to make them understand that *café au lait* is nothing in reality but *leather soup.*

The leaf of the coffee-tree is also used in the same way as the berry, being roasted and pulverised, and made into a beverage by infusion in hot water. In the year 1871, the late Mr. W. R. Alexander, of Redbank, drew attention to this form of use of coffee and prepared some samples, which were tried and approved by numbers of his friends. The advantage of the leaf over the berry is obvious in the facility with which the tree can be grown for its leaf in many places in Queensland where it would not answer to grow for its staple product. In Duff's "Notes of British Guiana" is narrated the following experience of a settler in Sumatra: "Engaged myself in agriculture, and being in consequence much exposed to the weather, I was induced several years ago, from an occasional use of coffee leaf, to adopt it as a daily beverage, and my constant practice has been to take a cup or two cups of a strong infusion with milk in the evening, as a restorative after the business of the day. I find from it immediate relief from hunger and fatigue. The bodily strength is increased, and the mind left for the evening clear and in full possession of its faculties. On its first use, and when the leaf has not been sufficiently roasted, it is said to produce vigilance; but I am inclined to think that where this is the case, it is rather by adding strength and activity to the mental faculties than by inducing nervous excitement. I do not recollect this effect on myself except when the leaf was insufficiently roasted. As a beverage the natives universally prefer the leaf to the berry, giving as a reason, that the former contains more of the bitter principle and is more nutritious than the latter.

"In the lowlands," says a writer on Sumatra, "coffee is not planted for the berry, not being sufficiently productive, but for the leaf. The people plant it round their houses for their own use. It is an undoubted fact that everywhere they prefer the leaf to the berry."

It is not generally known that the fumes of roasted coffee are an excellent disinfectant. The freshly ground coffee is placed on a moderately heated iron plate—a fire shovel answers the purpose,—and carried about rids a room of bad smells. It has been successfully used in purifying tainted air in a sick room.

A magnificent purple dye, analogous to the dye which produced the famed Tyrian purple, can be prepared from the alkaloid of coffee.

It speaks ill for the morality of trade that again and again it becomes necessary for me to refer to the adulteration of staples of commerce. Few articles are more subject than coffee to excessive and gross adulteration. Adulteration is said to be the natural inheritance of the English grocer, and it is very much to be regretted that in these days so much has this come to be regarded as an accepted fact by Governments, that prosecutions for these offences are now very rare, except where they involve infringement of a patent or a trade mark, or are distinctly prejudicial to health. About the year 1818 there were instituted in England a number of prosecutions against dishonest grocers for selling as coffee various admixtures in which coffee was sometimes the smallest ingredient. Heavy fines, varying from £20 up to £100, were inflicted, and the evil was thereby mitigated, but only for a time. A useful piece of advice is given by a quaint old writer, which my readers may take with advantage to health and pocket. He says:—"Never purchase from a grocer anything that passes through his mill. You know not what you get instead of the articles you expect to receive and that you pay for.

Coffee, pepper, allspice, and mustard are all mixed with substances which detract from their natural qualities." In pepper purchased from a respectable grocer in Brisbane I have distinctly traced sago, rice, and peas. The tradesman in question assured me that he was unaware of it, and that it had been done by the person to whom he had given the whole pepper for grinding. It came to my knowledge by accident, subsequently, that this rascal had made a large purchase of damaged split peas, for which he could have had no other use than as an adulterant. Nor are those safe who, as is done by some people in the old country, stand by while their purchase is being ground; as the grocer, who is determined to be fraudulent, supplies the adulterant by a cunningly devised contrivance at the back of the mill.

The chief adulterant of coffee is chicory. There are, in this case, people who use the mixture knowingly because it cheapens the coffee, and others who persuade themselves that it is an improvement on the flavour. Be this latter how it may, chicory has not a single qualification to make it a valuable addition to coffee; it is neither nutritive nor stimulating. As an adulterant used to increase the profit of the grocer, it is added often to the extent of 90 per cent., and as the cost of coffee is four or five times that of chicory the profit when the trade is large must be enormous. Chicory taken alone results in drowsiness, weight at the stomach, indisposition to exertion, and headache; so that any large admixture with coffee has not even the advantage of being like the chip in porridge, but is absolutely deleterious, the least consequence being that it gives diarrhœa.

Nor even in the berry itself is there perfect safety from chicory, as in 1850 a patent was taken out for an invention by which chicory was moulded into the form of coffee berries, the imitation being perfect enough to deceive any but the experienced eye.

There are numerous other adulterants of coffee, some of them being most revolting. Roasted grain of various kinds, peas, lupins, beans, carrots, parsnips, mangold wurtzel, acorns, mahogany sawdust, spent tan, baked horse and bullocks' livers, burnt sugar, venetian red, &c., have all from time to time been detected as admixtures with ground coffee. Liver baking is indeed a regular trade; the stuff when ground to powder being sold at 4d. to 6d. a lb. to the low-priced coffee shops. In 1850, out of 34 samples of coffee analysed by Dr. Hassall, many of them being high-priced and all under attractive names, 31 were adulterated; in many instances the quantity of coffee being exceedingly small, and the gross aggregate of admixture being not less than one-third of the entire bulk. Although alterations of the law, and exposures, have somewhat improved this state of things, it still continues more or less in all ground and tinned coffees. The obvious lesson which this teaches is, that everyone who wants pure coffee should roast and grind for himself, or at least have his coffee home ground.

In his work upon coffee and its adulterations, says the "Journal of Applied Science," Dr. Hagar arrives at the following conclusions:—The seed of the yellow lupine is really an excellent coffee surrogate; roasted in closed drums the seeds are very like the genuine berry in both taste and smell. The bitter taste is perhaps somewhat objectionable, but this can be greatly moderated by the addition of roasted rye. In such a coffee—surrogate of lupines and rye—there are more nutritive materials than in coffee itself, and the invigorating action of the mixture is not at all less. It might be at least advantageously substituted for the miserable chicory usually used as an adjunct, which as scarcely a trait of nutriment in it. In Dr. Hagar's opinion a mixture of one part of lupin seeds and two parts of rye forms a very palatable substitute for coffee, and if used in twice as great quantities is quite as nourishing and refreshing.

Another coffee substitute is referred to by Sir Joseph Hooker in the "Kew Reports of 1877 and 1881"—namely, the seeds of *Cassia occidentalis* of Tropical Africa. The following extract from a letter, dated 27th September, 1881, from Dr. Nicholls, of Dominica, is quoted in the latter report to show that their use is well known among the negro inhabitants of that island :—"*Cassia occidentalis* is, I find, an excellent coffee subsittute. It is called in Dominica 'L'herbe puante,' 'Café marron,' and 'Wild coffee.' I have often heard of the negroes using the seeds of a native plant as coffee, but it is only lately that I have inquired into the subject, with results that will, I believe, be of interest to you. I collected some seeds, and directed my cook to roast and grind them, so that I might taste their 'coffee.' Other matters engaging my attention, I forgot the circumstance until several days afterwards, when one evening my wife inquired how I liked my afterdinner cup of coffee. I turned to her inquiringly, when she laughingly said, 'That is your wild coffee.' I was indeed surprised, for the coffee was indistinguishable from that made of the best Arabian beans, and we in Dominica are celebrated for our good coffee. Afterwards some of the seeds roasted and ground were brought to me, and the aroma was equal to that of the coffee ordinarily used in the island. I may inform you that the plant itself is used by the native doctors medicinally in the form of a decoction, and it has the reputation of being a good diaphoretic. I will inquire into the matter, experiment physiologically on myself, and report the result to you. The weed is very common—indeed troublesome to the sugar planters,—so that if it turns out valuable, it can be obtained in large quantities."

The presence of chicory may fortunately be easily detected by the microscope; and chicory, peas, beans, lupins, and other adulterants of that class can be discovered by placing a portion of the suspected coffee gently upon the surface of cold water in a glass. If it be genuine it becomes very slowly moistened by the water, even when stirred up together, and in consequence floats on the surface and communicates hardly any colour to the liquid. This arises, says Pereira, from the coffee being impregnated with volatile oil which exercises a repellant influence on the water. Chicory, etc., on the other hand, readily absorbs and mixes with the water, to which it speedily communicates a deep reddish-brown tint, and sinks to the bottom of the liquid.

COLOCYNTH.

(*Citrullus colocynthis.*—CUCURBITACEÆ.)

This plant is a gourd, found commonly on poor sandy soils in Egypt, Palestine, Turkey, Coromandel, and the islands of the Grecian Archipelago. It is abundant also on the arid sandy tracts of the Punjaub; and it is cultivated in Spain. The fruit, which is of the size of a small orange, is globular in form, quite smooth, and when ripe of a yellow colour. The rind is hard and thin—the inside consisting of a white, tough, spongy matter, intensely bitter, and a powerful drastic. Taken in small doses it is a safe and useful purgative; but in large doses it is violently griping, sometimes producing bloody discharges with dangerous inflammation of the bowels. Its effect upon horses, however, is comparatively slight, and as a horse medicine it is extensively used. Of the two kinds which principally reach the English market, one is known as the Turkey and the other as the Spanish colocynth. There is a conflict of opinion among the authorities about the

seeds, which by some are described as nutty and perfectly bland and nutritious, and it is even stated that they are used as an article of food among the natives of Africa; others asserting that they are extremely bitter. It is certain that the seeds of the dried fruit, which form the raw material of the staple product, are bitter; but it is probable that this quality is acquired by them as the fruits mature, and that the seeds of the young fruits are palatable. Thunberg states that the Hottentots, and even the colonists of the Cape of Good Hope, eat the fruit after pickling in vinegar; but, although they are bitter, it is probable that when so used they are young and tender, and the drastic quality is not highly developed.

Baker, in his "Nile Tributaries," speaks of it as follows:—"Every now and then we discovered withered melons (*Cucumis colocynthis*); the leaves had long since disappeared, and the shrivelled stalks were brittle as glass. They proved that even the desert had a season of life, however short; but the desert fruits were bitter. So intensely bitter was the dry white interior of the melons, that it exactly resembled quinine in taste; when rubbed between the fingers it became a fine white powder. The Arabs use this medicinally; a small piece placed in a cup of milk, and allowed to stand for a few hours, renders the draught a strong aperient."

It will assist in determining the plant to say that the creeping stem is bristly, and the leaves hairy underneath. The colocynth is supposed to be the "Wild Gourd," and the "Vine of Sodom" of Scripture, and by some it is also thought to be the plant meant by the "Apple of Sodom." This latter theory is, however, not so probable as that the so-called apples were the produce of another plant, *Solanum Sodomeum*, which produces an apple-like fruit, handsome and tempting, like that of many of the solanums, but which, when ripe, is often found to be full of a gritty dust caused by a grub working among the soft parts of the fruit without any sign of its presence being externally visible.

The cultivation is like that of others of the family, but in perfectly drained soil and under full exposure to the sun. The fruit is gathered in autumn when ripe, its fitness for gathering being indicated by its turning yellow. It is sold both peeled and unpeeled, the former being the most common form. In the peeled form it is about 2 to 3 inches in diameter, and the unpeeled is something but not much larger.

The root of the Colocynth is white and branched, and its habit of striking deep into the ground will account doubtless in large degree for its thriving in such arid situations as form the natural habitat of the plant.

The "Extract of Colocynth," the commonest form of preparation from the fruit, is perfectly simple to make. The dried fruits broken up, the seeds being rejected, are macerated in water for thirty-six hours, being frequently squeezed with the hands, and the liquor is finally evaporated to the proper consistence for the use of the druggist. There are other more refined preparations, but the "extract" can be made by anyone who chooses to grow the plant.

In the powdered form the seeds should be excluded, and where present are regarded as an adulterant. Wheat flower and chalk are also used to adulterate the powder. As colocynth is one of the most valuable purgatives contained in the Pharmacopœia, its adulteration is a matter of considerable importance. Hassall says it is impossible to detect adulteration of colocynth without a knowledge of the structure of the fruit and seed; and he gives some beautiful illustrations of the surface of the fruit, of a transverse section, and of the seed, each magnified many diameters.

CONCH APPLE, or SWEET CALABASH.

(*Passiflora maliformis.*—PASSIFLORACEÆ.)

Like the Water-lemon this is a native of the West Indies, and is much cultivated for its fruit, which is about the size and shape of a large apple. The fruit is yellow when ripe, having a thicker rind than any of the other species, enclosing a sweetish pulp in which are lodged many oblong brownish-black seeds, a little rough to the touch. The cover of the flower is composed of three soft velvety leaves of a pale-red, with stripes of a lively-red colour; the petals are white and the rays blue. The flowers are large and very handsome though of short duration; this is compensated by for a succession of flowers for a long time. It is of common occurrence in the woods of Jamaica, supplying the wild pigs with a great part of their food in its season.

The plant rises to a height of fifteen to twenty feet by means of slender tendrils thrown out at every joint, with a thick triangular stem.

CORK-OAK.

(*Quercus suber.*—CORYLACEÆ.)

The value of cork for so many purposes involved in our daily life, the fact that for some of these no substitute has ever been found, and the numerous new uses to which cork is being put, all point to it as one of the most valuable products which the world has ever known. That we have a climate, and tens of thousands of acres of soil, suitable for its cultivation, provide every justificatiou for including the cork-oak among the economic trees worth cultivating in Queensland. It may be asked whether in so young a country the conditions of which are ever changing, and where landed property is seldom handed down from father to son, and the climate and soils of which are capable of producing so many things which are sources of earlier profit, it is worth while to trouble ourselves with a tree for the produce of which we must wait for half a generation. It may be argued that a tree which requires five-and-twenty years before acquiring any commercial value, and another quarter of a century to enable it to attain full perfection, is unsuited to the requirements of a people settling in a country with the idea, each in his degree, of acquiring an independence which his industry, intelligence, and frugality cannot secure for him in the old world. What—it may be asked—is the use of giving time and money to the cultivation of a tree the harvest from which our children *may* reap, but the full fruition of which can only be enjoyed by the second generation. My answer is to bid the objectors look back upon the history of Australian colonisation, and they will discover, within what is now comparatively a few years of its commencement, cases of successful importation and subsequent acclimatisation, by enterprising colonists, of both plants and animals from which Australia is now reaping an ample harvest of substantial wealth, and which have largely contributed to obtain for the country its high standing among British dependencies, and its name as a home for England's surplus population. Such bright examples of foresight may well be imitated by the present generation of colonists, either individually or by means of governmental or other organisation. We do not hesitate to pledge the resources of the colony to pay debts at a period sufficiently long for this tree to mature its products, and we may well consider whether by its means we may not increase those resources so as to assist in meeting our distant engagements as

they fall due. The time will inevitably come when the neglect of the important subject of forest conservancy will make itself felt, even though that day may be distant in so well-wooded a country. I venture, however, to prophesy that before Queensland has doubled her present age it will be a subject of regret to the governing men of the colony that their early predecessors failed to foresee that, in time, our timber resources would fail, and that in the train of reckless destruction of our forests would come the injurious climatic results which have befallen other countries from similar want of foresight.

The subject of this paper might be made to form an important element in any system of forestry for the future wants of our rapidly growing community. It is found in its natural state principally in Spain, Portugal, in the South of France, in the southern provinces of Italy, and in Barbary. It is also more or less largely cultivated in those countries; while in Algeria the French Government have some 500,000 acres of cork plantations, to the preservation and development of which the greatest attention is paid. A large staff of officers have charge of them, and they are said to yield a large revenue to the State.

But with all the natural and cultivated production of cork, fears are entertained that there will before long be a dearth of fine cork for stoppers.

The cork-tree requires a warm, or at least a temperate climate. It succeeds at various elevations, according to climatic conditions, growing in Algeria at as high an elevation as 3,200 feet. It prefers slopes to plains, particularly if near the sea; free circulation of air and an abundance of light being highly beneficial to the development of the tree. It thrives best in granitic, slaty, or siliceous soils, objecting strongly to the purely calcareous. The soils must be well drained, damp lands being fatal to successful growth.

There are several varieties of the tree, distinguished chiefly by the period at which they ripen their fruit. In height it ranges from 30 to 40 feet, and in diameter from 2 to 3 feet. The tree begins to bear acorns within 12 or 15 years, but until it reaches 30 or 40 years the acorns are not fertile. The acorns soon lose their germinative faculty, especially if exposed to a great degree of cold.

Various systems of planting have been used; but the best consists in the acorns and vines in alternate rows, the rows of vines being from 5 to 7 feet apart, and the acorns planted in furrows between the rows, at intervals of about 30 inches apart. The young trees are subsequently thinned out to suitable distances. Where this system has been adopted the yield of the vines has more than paid for the cost of the cork plantation. For some years the vines afford shade, without which the young trees do not thrive; but in course of time the mutual operation is reversed until eventually the vines begin to suffer, and the plantation is ultimately abandoned to the cork trees alone. Twice at least in the year these mixed plantations must be cultivated with the hoe.

The seeds of *Pinus maritima* are sometimes sown with the acorns to afford shelter and prevent extreme variations of temperature. As space is required the pines are made to give way to the oaks, the sale of the timber from them paying for the plantation and becoming a source of profit.

The other methods of planting involve no special features, but are adapted to various conditions of soil, elevation, slope, natural timber, &c.; and proposing planters in Queensland, knowing the requirements of the tree, will have no difficulty in adopting a suitable plan in each case.

Autumn planting is recommended in order to allow the young roots to get hold during the winter, and thus to prepare the seedling trees for a vigorous growth during the succeeding summer.

At a certain stage of maturity the tree sheds its bark, but the produce thus obtained is not nearly so valuable as the bark artificially removed.

The process of barking for the market is seldom practised on trees of less age than 25 years, and even then the cork is of little value. Ten years after the growth of bark is again removed, but even then, at the age of 35 years, the bark is not thick enough to make good corks. The best authorities appear to concur in the belief that the bark does not attain all those qualities, for which cork is esteemed for its most important uses, until the tree has reached the mature age of 50 years.

The trees are stripped once in every eight or ten years, and the process, so far from injuring, is said to prolong the life of the tree. When the excess of the natural growth of the bark is not artificially removed the tree seldom lives more than 50 or 60 years; while, on the other hand, trees which are regularly stripped flourish for 150 years.

Great care is, however, requisite in the process not to injure the tender laminæ of the *inner* bark, as in such case no further deposition of cork-bark would take place.

The process of preparing for market, after stripping, differs slightly in the several cork-producing countries ; as in Catalonia, for instance, the bark is boiled after stripping. It is the universal practice to char the sheets on both sides—at all events, when it is required for the purpose of manufacturing stoppers. This process causes it to contract, thereby increasing its density, and so better fits it for the purpose of excluding the external air.

There are two sorts of cork—viz., the white and the black, the former being produced principally in France, and the latter in Spain. The white kind is, however, held in the highest estimation, being finer in the grain, and cuts smoother and with fewer knots or cracks.

The bark is taken in a manner very similar to that by which, in Australia, bark is removed for roofing and other purposes, by making coronal and vertical incisions, at periods of the year during which the condition of the sap makes the separation from the tree easy. After being detached it is steeped in water and flattened by pressure, then slowly dried, charred, and bound up in bales for the market. In the process of drying, which takes about two months, it loses one-fifth in weight.

The quantity of bark removed from a tree at one time, and the intervals allowed to elapse between one barking and another, differ according to the theories upon those points held by different growers. For obvious reasons the strain upon the tree is less when the entire bark is not removed at once ; but it is practised by some, and when done with every care not to injure the inner bark, the next crop, although produced more slowly, is of better quality than when the tree is only partially stripped.

At a recent meeting of the members of the Auckland Institute, Mr. Justice Gillies read the following paper on the growth of the cork oak in Auckland :—"In the public newspapers, and in the utterances of members of Parliamentary Committees for the encouragement of native industries we periodically find suggestions as to the growth of the Cork-oak in New Zealand. The following facts may, therefore, be not uninteresting as affording data by which to judge of the economic value of the Cork-oak in New Zealand. In the year 1865 the late Dr. Sinclair planted, close to his house, near Symonds street, a young cork-oak received from Kew. It is now about 40 feet in height, 14 feet from the ground to the first branch, with a spread of top about 40 feet in diameter. The trunk at 3 feet from the ground is 5 feet 8

inches in circumference after stripping. For several years past it has produced acorns, from which the present occupant of the grounds, Mr. John Hay, has raised a large number of young oaks, and distributed them liberally throughout New Zealand. In the summer of 1877 I stripped it for the first time and got a large quantity of virgin cork, which I did not weigh, the first stripping being of little or no commercial value. In February last I again stripped it, and after drying the bark, found the products to be of 70 pounds weight of good, marketable cork, fit for pint corks, as I am informed by Mr. Dutton, the cork cutter, who was present at the stripping, and states it to be worth at least 60s. per cwt. It will thus be seen that the trees must be twenty-five to twenty-seven years old before producing any return, and then every five years may produce 70 pounds to 100 pounds weight of marketable cork. The produce improves in quality with each stripping, On comparing the New Zealand product with the imported bark, it is evident the annual growth of the bark in Auckland is quite equal to that of the import. I present herewith to the museum a sheet of the cork of last stripping, 3 feet 4 inches by 1 foot 4 inches, which shows the character and quality of the cork, and is, I believe, the first produced in New Zealand. I also present a section of one of the branches, showing the mode of growth of the virgin cork."

The value of cork plantations varies considerably according to locality, the age of the trees, density of growth, and the quality of the cork produced. But as the demand for stoppers increases every day, the cork plantations acquire additional value. Large sums are invested in Spain in this class of property, and handsome profits are made out of the plantations.

The minor products of the cork-tree consist in the mother bark, which contains a large amount of tannin, equal to the best oak bark; and in the timber. Cork-trees grown for tan bark are usually stripped every thirty years, at which age they are entirely denuded of every portion, including the inner bark. This kills the stems, which are then cut down to the roots, from which spring new shoots which in their turn are subjected to the same process. The roots, however, gradually become weaker, and in eighty years they cease to send up new shoots.

The wood of the Cork-tree is of a reddish-brown. Exposed to changes from wet to dry, it soon warps. It is very tough, and for that reason is used for carriage and waggon making and for similar purposes. As the wood is heavy and easily warps, and the trunks are short, it is seldom used in house-building. In naval construction, curved pieces which are continually under water and fastened with copper bolts are very durable. Iron bolts cannot be used on account of the tannin contained in the wood. It also makes good piles. The charcoal is very good, the yield being 18 per cent.

For many of the inferior purposes to which cork is put, the bark is available long before it is fit for stopper-making. The uses of cork in its inferior and less mature forms are numerous and increasing. The merest fragments, which would otherwise be absolute waste, are now largely utilised in the manufacture of floor covering known by the names of "kamptulicon," "linoleum," etc.; the durability and elasticity of which are in a large measure owing to the cork powder which forms the principal base in their manufacture. Cork is the chief buoyant element in life-boats, belts, buoys, mattresses, and other life-saving apparatus at sea. As a lining for the soles of shoes it dates back at least as far as 1664; and from this application of cork it derives its German name of "pantoffelholz" or "slipper-wood." In Spain, among the poor, sheets of cork take the place of bedside carpeting. and it is also used there as a warm dry lining for the inside of houses. The colour known as Spanish black, used in oil painting, is made from cork.

What is known as "virgin cork" enters largely into ornamental gardening, especially under glass; being used in the construction of flower boxes and artificial rockeries, and also as blocks for epiphytal orchids. Very thin sections of cork, 50 to 120 plates to the inch, are also used in the manufacture of hats.

Powdered cork has some value in medicine as a styptic, owing its astringency to the presence of tannic acid; and it has also been used, in conjunction with sugar of lead and lard, as an application to piles.

Superstition attributes to it, in various countries, virtues of many kinds. For this, however, and much other interesting matter, the scope of these papers permits no room.

Trees showing the earlier characteristics may be seen at Bowen Park, Brisbane; and much older specimens are to be found in Sydney, in the Botanic Gardens; at Vaucluse; at Parramatta; and, I believe, at Camden Park, the seat of the Macarthurs.

DAWA.

(*Nephelium pinnatum; Pometia pinnata.*—SAPINDACEÆ.)

This is a tree attaining the height of 60 feet, and producing a good timber. In Fiji it frequently forms entire forests, and it has been found at Tanna, Rotuma, the New Hebrides, the Tongan group, and New Caledonia; and is in all probability more or less common on all the islands of the South Pacific. Although the flowers themselves are insignificant, being produced in long spikes, they are effective; but the bright red tinge of the quite young leaves produces a handsome effect equal to brilliant bloom. The fruit is about the size of a pomegranate, and is described as having a honey-like flavour, and being somewhat glutinous to the palate. Plants received from Fiji have repeatedly been distributed among the gardens on the northern coast of Queensland. A very fine coloured illustration, showing flower, fruit, foliage, and the peculiar tint of young leaves, is given in Seemann's magnificent work "Flora Vitiensis;" to my copy of which any person is at liberty to refer who wishes to determine if he possesses the tree.

EARTHNUT, GROUNDNUT, or PEANUT.

(*Arachis hypogæa.*—PAPILIONACEÆ.)

An annual plant of trailing habit. The Arachis is supposed to be of African origin, but it is now found wild and cultivated in so many parts of the world that its original habitat is difficult to determine. The extensive spread of this plant over the earth's surface is attributable, of course, primarily to the esteem in which it has been held for its economic and industrial uses; but has been, doubtless, largely facilitated by the extraordinary vitality of the nut, which is reputed to have remained unimpaired after forty years of keeping.

It is largely cultivated in the warmer parts of the United States and of South America, in the East and West Indies, Cochin China, on the coast of Africa, in the Islands of the Indian Archipelago, and to some extent in the south of Europe. The cultivation in the East Indies actually recorded amounts to 112,000 acres; but large allowance must be made for excess over this acreage from innumerable small areas, the aggregate of which amounts probably to some thousands of acres additional.

The plant is very productive, and yields a quick return, being from eight to nine months in the ground, and is one of the hardiest and most valuable of the productions of husbandry. It thrives in a light and sandy soil, and is usually grown in common, dry, arable lands; indeed it will thrive tolerably well in such indifferent soils as are unfit for the growth of almost any other production.

The colour of the pods always partakes of that of the soil; and, as the brightest pods always bring the most money, so a light gray soil is to be preferred. When harvested they are perfectly clean, not a particle of soil adhering to them. Not so with red or chocolate-coloured lands. These leave a stain on the pods, of which they cannot be divested even by washing, a practice frequently resorted to for the purpose of getting a fancy price.

Peanuts requiring a clean soil will follow any hoed crop with advantage except sweet potatoes. Corn land is generally preferred. They will not, however, fruit, although they may grow with vigour on any other than a calcareous soil. If, therefore, lime is not actually present, it must be supplied with no sparing hand.

The yellow, pea-shaped flowers are produced from the axils of the leaves, in bunches of from five to seven. After flowering the flower stalk gradually bends down, and forces its point with the incipient pod into the earth, where it gradually swells and ripens with a pale-brown rugged exterior of irregular shape, with about two nuts to each pod. The external shell, which is brittle and easily detached, weighs about one per cent. only of the fruit. The yield as a crop varies from 20 to 120 bushels to the acre, according to the quality of the soil, a bushel weighing from 25 to 32 lbs.

There are two very distinct varieties of the peanut, both of which have been introduced into Queensland; the only material difference between them being that one has a large pod and the other a small one.

The best selected seed must be used in planting, and care must be taken to ascertain that its vitality has not been impaired. Before planting, the pods are carefully shelled, and every faulty bean is discarded. It takes about two bushels in the pod to plant an acre.

The following is the method of cultivation of this crop adopted in the States. Having selected the ground, it is to be ploughed with a one-horse plough in March or April to a depth not exceeding four or five inches. The advantages of shallow culture will be apparent from the fact that the peduncles continue to penetrate the earth until a firm bed is reached on which to deposit the nut; and the still further fact of the increased facility afforded in harvesting, as will appear when we come to treat of that branch of the subject.

About the 10th to the 20th of May is the time for planting. If the land is thin and needs manuring, open furrows three feet apart, and strew in a hundred to a hundred and twenty-five pounds of peruvian guano, or from a hundred and fifty to two hundred pounds of superphosphate of lime. The former is generally used, because of the greater certainty of getting a pure article, but nothing can be better than the latter when well prepared. The furrow is then to be ridged over and the whole surface thrown into three-feet beds, which should be reduced to within two or three inches of the general level of the field. Then mark off the rows, and at distances of eighteen inches plant two seeds, covering them an inch to an inch and a-half deep—not more.

In ten days to two weeks, according to the weather, the young plants begin to come up. As it is very important to get a good start, the missing hills should be replanted at the earliest moment. It is the custom of some

planters to put an extra quantity of seed in every fourth or fifth row to furnish plants for transplanting, if needed; if not needed they can be thinned out.

As soon as the grass makes its appearance give a light ploughing, throwing the earth from the vines and following with the hoe, thoroughly removing all the grass from the row. Plough again as soon as the grass reappears, this time using a double shovel or cultivator, and the hoe as before directed. If the season should prove to be very wet, a third working may be necessary, making use of the cultivator and hoe again.

Next comes the time for laying by, the vines having extended nearly half way across the space between the rows. This is done by running a mould-board once in the middle between the rows, and drawing the earth up to the rows with the hoe, care being taken not to cover the vines and to disturb their position as little as possible, as the fruit will now be forming. It will be necessary also to guard against making the bed too high. When there is grass in the row it must be pulled up by the hand. Soon after this the vines will cover the whole ground and repress every other growth, unless it may be a chance weed that escaped notice at the former working.

The time for harvesting the crop is from the 15th to the 30th of October, immediately after the first frost. When the crop is forward, or when it is an object to get a portion of it early in market, the operation may be commenced in the latter part of September; but the longer the vines continue to grow, the greater will be the number of sound pods. Select a time when the weather is settled and favourable, and with three-pronged hoes loosen the vines along the rows. Hands follow the digger, pull up the vines, shake the dirt from them and leave them in the same place. In dry weather they will be sufficiently cured in two days to be shocked. Showery weather, though it may somewhat delay the curing, does no injury.

One of the advantages of shallow culture becomes apparent in harvesting. When the fruit is deposited only a few inches below the surface, the vine is detached from its position with little or no loss; when the depth is greater, the stems or pedicles are liable to be broken off.

In shocking, provide stakes seven feet long, made sharp at both ends; then lay two fence rails on the ground as a foundation, but with supports underneath to afford free access to the air. The stakes are stuck in the ground at convenient intervals between the rails, the stacks built up around them, and finished off by a cap of straw to shed the rain. The diameter of the stack is made to conform to the spread of a single vine.

After remaining about two weeks in the stack the picking should be begun, taking off none but the matured pods. These are to be carried to the barn, and prepared for market by completing the drying process, and then fanning and cleaning.

The most tedious part of the work is the picking. An expert discriminates at a glance between the mature and immature pods, but cannot pick more than two and a half or three bushels per day. A machine to perform the operation would be a most valuable invention. Unless the management in the barn is carefully conducted, there is great danger, where there is much of a bulk, that the peas will become heated and mouldy. The condition in which the early deliveries are often received at market renders this caution quite necessary—in fact, there is as much slovenliness in the handling of this crop as there is in regard to any other; perhaps more, for the reason that so many inexperienced persons engage in the culture every year. Until the pods are thoroughly seasoned, the bulk should be frequently stirred and turned over.

A certain classification in respect to quality obtains in peanuts as in every other article of agricultural produce. The descriptive terms in general use are "inferior," "ordinary," "prime," and "fancy"; but these are not so definite as to admit of no intermediate grades.

One of the best Indian authorities recommends that the crop be grown in fresh ground every year; the chief objection to this being that, owing to the small nuts which necessarily escape the harvest, it is rather a difficult plant wholly to eradicate from land with which it has been cropped.

The uses of the groundnut are numerous, but its chief value as a commercial product is for its oil, which is thin and of a clear, pale, straw colour, resembling poppy oil and the finer kinds of olive; and not only does it not become rancid, but even improves with age. The yield is variously stated at from 16 to 50 per cent. of oil, the quantity being increased by heat; but, as in the case of the product of the olive and castor bean, the quality of the oil is not improved by the application of heat for its extraction. Nut oil, as it is commonly known in commerce, is largely used as an adulterant of olive, sesame, and cocoanut oils, as well as a substitute for olive oil; while it possesses the enormous advantage over olive oil in being the product of an annual plant, instead of requiring many years for the plant to mature which produces it. The lubricating properties of the oil are superior to many others in use, both on account of its purity and for the reason that it does not gum. It is free from stearine, and is much used by watchmakers, and for delicate machinery of all kinds. In the United States three qualities are made, one being extensively employed in medicine, another for burning purposes (possessing the virtue of not smoking), while the third is applied as a salad condiment, and for various alimentary purposes. It is also used for cloth-dressing and in the manufacture of soap. Enormous quantities of this oil are manufactured in France, and find their way about the world as olive oil; and there is no reasonable doubt that we purchase here the imported article under the name of olive oil, which we could make at half the cost, and of better quality, for ourselves.

The residual product of oilcake, after the expression of the oil, is very rich in fattening as well as in fertilising qualities. In Java, after the expression of the oil, by means of two simple wooden rollers, moved by the labour of cattle, the cake which remains is used as a dressing to cane lands; and in the lands attached to the Chinese manufactories of sugar may be seen the cultivation of the sugar-cane and of the ground-nut judiciously combined, both for the sake of the oilcake as a manure for the cane lands, as well as for the occasional intervention of a green crop. The leaf of the plant resembles clover, and, like it, affords excellent food for cattle; to which purpose it is applied, both in the green state as well as dry, after the harvesting of the crop of nuts.

The uses of the groundnut are far from exhausted by describing it as an oil producer. Enormous quantities of the parched nuts are consumed as an article of food, and they are also eaten boiled. They abound with starch and albuminous matter as well as with oil; and as a source of food are considered superior in flesh-producing constituents to any other vegetable product of similar character. In India the nut is much eaten by the poorer classes, and as an evidence of the esteem in which it is held in the United States, and the enormous extent in which it is there consumed, may be mentioned the fact that in 1870 the crop of "peanuts" in the Southern States amounted to a million bushels. In 1880 the crop was estimated at a total of 2,820,000 bushels. This, at the low estimate of 22 lbs. to the bushel, gives the enormous figure 62,040,000 lbs.; which, on an average of 4 cents. a pound, would reach 2,481,600 dollars—£51,700.

The nuts, parched and ground, can with difficulty be distinguished from coffee, into the adulteration of which they doubtless enter; while one American writer of authority states that the manufacture of chocolate cakes out of the groundnut alone, and without a particle of cocoa, is an immense and profitable manufacture in the States. Made into a soup they are rich and nutritious, and make an article of food in that form which is a substitute for meat. Parched and beaten up with sugar they are also served with dessert. Large consignments reach England from the west coast of Africa for the expression of the oil; in the year 1873 no less than 15,000 tons of shipping being employed in this trade alone thence.

Barham, in his "Hortus Americanus," says that the nut beaten and applied as a poultice is an antidote for the sting of scorpions, wasps, and bees.

In September, 1880, Mr. E. A. Carman, the Assistant Commissioner, Department of Agriculture, Washington, supplying information upon the subject of this crop at the request of the writer, among other items gives the following:—"Analyses made in this Department have demonstrated that the peanut, under favourable circumstances, will yield at least sixteen per cent. of oil, and it has been found that for alimentary, mechanical, and illuminating purposes, the oil is scarcely inferior to the linseed or the olive. The amount of oil varies according to latitude. The cultivation of the peanut has been gradually extended in the southern portions of the United States, especially in Virginia, where it has become a staple and profitable crop. Thousands of acres are annually cultivated, and the crops yield on an average fifty bushels to the acre. The greatest value of the production is substantially overlooked, the crop being monopolised by the unceasing demand, not only of the circus and similar demonstrations, but of almost every street corner of every city, where a peanut stand seems to be a necessary feature of street architecture and accommodation. In Europe and Africa, on the other hand, the nut is grown almost exclusively for the sake of its oil. Many thousands of tons are annually imported into France for the purpose of expressing the oil, which, it is stated, finds its way into the trade under the name of olive oil, which can hardly be called an adulteration, as *the peanut oil possesses a delicacy and sweetness not easily surpassed.*"

"Such," says an eminent author, "and so varied and important are the uses to which this simple product can be devoted, uses to which the uninformed, who have perhaps regarded it only in the light of an indigestible bulb, would never suspect to proceed from its cultivation." To the farmer on our Queensland coast lands, who complains so much, and with such reason, of the uncertainty of his profits arising from the favourite crops of hay and corn, the groundnut ought to present peculiar attractions. Simple of cultivation and certain in its produce, easy to convert into a staple product, and affording manifold uses for domestic purposes and for the home market, the circumstance that it is not extensively cultivated is simply surprising, and is only to be accounted for by want of enterprise or of knowledge of the value of the crop. The latter I have endeavoured to supply, and it only remains to hope that the very moderate enterprise involved in the cultivation of experimental crops of this valuable plant may not be wanting.

I am convinced that, if intelligently engaged in, the cultivation would soon prove itself to be profitable, and that this simple plant would ere long become a source of considerable wealth to the colony.

ELEPHANT—or WOOD-APPLE.

(*Feronia elephantum.*—AURANTIACEÆ.)

This is a large deciduous tree found throughout India, and in Ceylon and Java, in dry situations, ascending to a height of 1,500 feet. It is also a good deal cultivated in India. It has a symmetrical trunk reaching to four feet in girth. Both leaves and flowers have a strong smell of anise, and at the axils of the leaves are stout straight thorns. The bark is dark-grey or nearly black, corrugated with long shallow furrows. Although not so valuable a tree as the Bael-fruit, the Elephant-apple possesses uses which entitle it to rank among economic trees. The flowers, which are of a dull-red colour, are followed by round pale-green fruit about the size of a cricket ball from $1\frac{1}{2}$ to 2 inches through, with a hard external shell; the interior is full of a brown soft mealy subacid substance, not very palatable uncooked, but convertible into a very pleasant jelly, which is hardly distinguishable from black currant jelly. The leaves are used as a stomachic and carminative.

A white transparent gum, used for medicinal purposes, exudes from the bark; it much resembles gum arabic, and together with the gum from a number of other trees, including the mango and acacia arabica, forms part of the East Indian gum arabic of commerce. The Elephant-apple is also one of the trees upon which the Lac insect works. The timber is hard, close-grained, and tough, and is used for various purposes for which these qualities are especially useful. The tree can be propagated by seed or cuttings. This tree has been frequently introduced into Queensland, and has been largely distributed.

ESPARTO-GRASS OR ATOCHA.

(*Stipa, or Macrochloa, tenacissima.*—GRAMINEÆ.)

It is only comparatively of late years that this remarkable grass, which now forms an important staple of commerce, has come into prominent notice. Long known among the populations of the countries to which it is indigenous for the great strength of its fibre, which rendered it invaluable for a hundred uses, it was laughed at by the paper-makers when first suggested as a substitute for rags in that huge industry. The manufacture of paper, however, increased so rapidly that the supply of rags fell far short of the demand, and manufacturers, forced to seek for other raw material of which the supply should be practically without limit, and which was readily reducible, found it, after all, in the esparto-grass, at which they had sneered when it was first proposed to them.

"Thus," says a writer, 13 years ago, "after 200 years of experiment, and the trial of a thousand different substances, just when the civilised world feels its necessity the most, a perfect substitute for rags has been found, and will be used wherever a book is read and the art of writing known." So advanced are the processes now by which it is converted that it has been claimed that a cargo arriving in London in the morning has been converted into paper before night.

The plant is a native of Spain and of Southern Africa. "A portion of the Sahara," says the celebrated German traveller, Dr. Gerhard Rohlfs, "known as the little desert, comes within the influence of moisture-laden winds and is clothed with vegetation. One of the most useful plants covering the whole district is "esparto." Long known and utilised for mat-making, it is only of late years that the true value of this plant, which requires neither care nor culture, and thrives with a minimum of moisture, has been recognised."

The word "sparto" or "esparto" has its origin in "spartum," the name given by the Latins to a fibre held in great esteem for the manufacture of cordage, &c.; and by some the two are supposed to be identical. Dr. Forbes Royle, however, thinks it probable that in the "spartum" of the Romans was included both what are now known as "esparto-grass" and "spartium junceum"—the sunn hemp; the term being used as a generic name in much the same way as "hemp" is now-a-days applied alike to the products of wholly different plants. It is also supposed to be the "rush of a dry soil" referred to by Pliny.

Dr. Schomburghk states that it grows on the poorest soil, especially limestone and sand—in fact, that where nothing else will grow esparto-grass will flourish. This plant, however, like all others which will grow in poor soils, has its congenial conditions under which it thrives best, and which will evolve most fully those qualities which give it its commercial value. It is rarely seen above 3,500 feet of elevation—in fact, when the snow commences esparto ceases to grow.

The United States Consul at Adra, Mr. Frederick Burr, who has studied the habits of the plant in Spain, and reported exhaustively to his Government on the subject, says:—"Calcareous soils are considered to produce good esparto and of very strong fibre. Argillaceous soils, whether those produced by the decomposition of shaly rocks or those formed by the wide deposition of tertiary marls, are impregnated with nitrous matter or saltpetre, and are considered favourable to the growth of the esparto, the grass being shorter but the fibre stronger.

"The leading facts in the production of esparto may be stated as follows:—(1) The atocha grass requires a decidedly hot and a somewhat dry climate. (2) That it grows equally well in the plains of the coast and the interior, and in the mountains, but is strictly limited to a certain moderate elevation. (3) That it flourishes equally both in calcareous and argillaceous soils, and in those soils where both calcareous and argillaceous matters are naturally blended. That besides several soils which may be considered unfavourable, there seem to be others which are decidedly inimical to its growth."

To show how strongly the conservation of this valuable plant is urged in France, the following extract is given from the journal *L'Exploration*:—"As in France laws have been made against the falling and destruction of forests, so must the Colonial Government concern itself with the protection of this great staple of the high plateau, and severely punish the burning by the Arabs and killing of the plants by careless gathering. It must not be lost sight of that all Europe and America are dependent on Algeria, and that, should the whole esparto district be carelessly left to greedy robbers, who care little for the public property, nothing will at last remain but a neglected waste."

As a fodder it possesses little value, Dr. Rohlfs stating that it has a powerfully constipative effect, and that the shepherds on the edge of the desert drive their flocks every third or fourth day to drink at mineral springs to counteract the binding action of the esparto feed. Camels and sheep soon tire of it.

The plant grows in thick bunches close together, with a broad base, tapering to the top, and attains a height of from 6 to 10 feet. In the cylindrical form of its stalk it resembles a rush. In harvesting it is pulled instead of being cut. If this is not done carefully the roots are disturbed, with the consequence of great waste. Indeed, in the African coast district the plant is torn up by the roots, and so sent to market, a method analogous to killing the goose that lays the golden egg. This rough method really

involves more labour than is necessary, as if gathered at the proper season, viz., just at maturity, the leaves part from the socket without difficulty, and the root is left undisturbed for another crop. By the other method the operator protects hands and legs with gloves and boots, and then twists the stem round a stick in order to obtain a better purchase, even with the aid of which the gathering is very hard work. If gathered green it makes a transparent fibre of little value; if too dry the constituent elements of silica and iron are difficult to remove. That grown on the sea-coast is the best.

The preparation of the crop for the paper mill is the simplest possible proceeding, the grass being dried in the sun just like hay, and then tied into convenient bundles and conveyed to the nearest shipping port. Although of a dry and wiry nature it loses about one-fourth of its weight in drying.

"The quantity of esparto produced from a given extent of land," says Mr. Consul Burr, "will vary greatly, the grass being in some places very luxuriant and abundant, while in others where the soil is less congenial it is more thinly dispersed in tufts and patches. This grass seems to last for an unknown number of years, so that where it has taken possession of the soil it becomes a perpetual growth. Thus in any soil congenial to its growth the 'atocha' is self-propagating, and without further cultivation or attention of any sort it furnishes a never ending annual crop of esparto. All persons with whom I have spoken agree that the esparto improves by a regular yearly gathering, and that the plant is found to become stronger in consequence. But the gathering requires some little care. The grass (which readily separates) must be plucked up, but without pulling up or injuring the roots. If the roots be disturbed, as may be the case, by careless or ignorant people, or those who greedily seek to increase their wages by pulling up the entire plant, thus augmenting the apparent weight of esparto gathered, the atocha is destroyed and no more grass will be gathered on that spot."

When harvested by the native population in Spain for conversion into the various articles for which it is largely used, the process of preparation is different. After gathering, the grass is left in a heap for two days. On the third it is spread out and exposed to the heat of the sun until dry; then remade into bundles and macerated in water, salt water being preferred. It is once more dried, again wetted, and is finally beaten before it is ready for use.

The quantity of esparto-grass available in the wild state would be practically illimitable, were the labour of the native population more reliable and their method of gathering better calculated to send the article to market in a form requiring a minimum of treating by the manufacturer. It yields to the paper-maker nearly as much pulp as average rags yield, is no more difficult than rags to work up, and in many respects is preferrd to them. But to compete with rags upon even terms it must come to the manufacturer in a state requiring no additional stage of labour before it is ready to undergo the first operation towards reduction to pulp. Dr. Rohlfs is of opinion that this plant is an inexhaustible source of wealth to all Northern Africa. In Algeria alone there exist some seven or eight millions of acres of esparto. The greater part of the produce of Spain and Africa goes to England, but the Americans are beginning to import for themselves direct from Africa. Tunis, Tripoli, Cyrenaica, and the Libyan coast plateau stretching to Alexandria, all export esparto; but the frequently disturbed condition of these countries renders the supply uncertain, so that Spain and Algeria enjoy almost a monopoly.

In 1879—the most recent date of statistics that I can find—the total imports of esparto and other vegetable fibres into London reached 162,000

tons; but this enormous quantity, of which the miscellaneous fibres, other than esparto, formed a very small proportion, fell short of the demand. Prices ranged from £6 10s. to £7 10s. for Algerian, to from £9 12s. to £10 7s. for Spanish.

Dr. Schomburghk, one of the most eminent authorities upon industrial botany in Australia, expresses the opinion that by the cultivation of esparto grass many thousand acres of arid land, scarcely fit for pasture, might be rendered productive districts. The plant is as easily cultivated as rice or hay. It is of rather slow growth, but although inhabiting poor and arid soils, the experience of Spanish growers shows that a soil of good depth and moderate moisture gives a stronger and healthier plant in less time. It is raised from seed or by division of the plants. There appears to be some difficulty about the seed. A small quantity obligingly placed at the writer's disposal by Dr. Schomburghk, and handed to Mr. Pink, of the Botanic Gardens here, did not germinate. Messrs. Vilmorin, Andreux, and Co., of Paris, writing to the Agricultural Department of the United States in 1868, speak on this point in these terms:—

"As we told you in our former letter, seed of this plant is not in commerce. Many times we tried to procure it both in Spain and in Algeria, but always were informed that it does not yield fertile seed, and was propagated only by division of the old plants some way similar to the propagation of the sugar-cane, and it is by a mere chance that we have got the seed we have forwarded to you. A friend of ours, when in Spain some ten or twelve years ago, cut some of the flower stems of the esparto-grass, and on his return to France tried to sow the seeds he found in these specimens, and a very few did grow. He cultivated carefully the young plants, but all the seed he could collect remained sterile; he at last tried artificial fecundation, and succeeded this year to a certain extent. In continuing the experiment he has been able to collect the seeds we have got this year."

The seeds should be sown broadcast, and if they come up too thickly the thinnings can be planted out and will grow readily. Subdivision of the roots requires no special directions—it is as easy in the case of this plant as in that of the guinea-grass so familiar to many Queensland farmers. Whether grown from seed or subdivision a foot apart is sufficient distance for the plants.

Esparto is now extensively planted in the South of France, and is said to pay well, yielding from 6 to 8 tons per acre. As the cultivation and preparation for market are most easy, climate congenial, an unlimited area of suitable land, and a constant and certain market available, there exists every inducement to the Queensland farmer to grow it as a crop, especially in cases where a mistake in selection has been made, and he finds himself saddled with land poorer than he believed it to be when taking it up.

The uses to which esparto-grass is put in countries to which it is indigenous are, as I have said, very numerous, such as sacks, sheep-nets, mattresses, shoes and rustic clothing, baskets, matting, ropes of all sizes, and when properly prepared it is put to various fine purposes for which in other countries flax and hemp are used. It is also curled to imitate horsehair, for which purpose it is highly prized, being very durable.

Apart from the strength and elasticity of this fibre, it is claimed for it that it is free from liability to harbour vermin, and that it is not injured by constant exposure to moisture.

At one time in Spain, esparto was being largely used in the manufacture of a sort of sandal called "Alpergates," in which a large trade was carried on with the Indies. The peasants in many parts of Spain still hardly ever wear any other kind of shoe. It also enters largely into the manufacture of carpets in Scotland, England, and Brussels.

Another rush-leaved plant, "Lygeum Spartum," is also used and known as esparto by the Spaniards. The character of growth of this plant is different from that of "Stipa tenacissima." Having a creeping root-like stem, it would be apt to spread very rapidly, and if once rooted a few plants would soon take possession of a large tract of country.

In connection with the use of esparto as a paper-making material, it may be interesting to mention that the annual consumption of paper in different countries is estimated as follows, viz.:—England, 13¼ lbs. per head; America, 12 lbs.; Germany, 10 lbs.; France, 8¾ lbs.; Austria, 4½ lbs.; and Russia, 1 lb.

GINGELLY—TIL—or TEEL-OIL.

(*Sesamum orientale, S. Indicum.*—PEDALIACEÆ.)

The Sesamum is a showy annual plant, indigenous to India and the whole of southern Asia, from Japan and China to the shores of the Mediterranean, and is largely cultivated in many places over that enormous area as well as in Africa and Brazil. Although a native of, and chiefly cultivated in, hot climates, it may be successfully grown in more temperate regions.

The points of distinction between the two species are unimportant; nor is the difference in yield of oil, if any, at all material. Three varieties of seed, the white, black, and red, reach the market. The black kind is reputed to mature sooner than the others.

The principal product of the Sesamum is the oil expressed from the seeds. This oil is of a straw colour, clear and limpid, sweet as oil of sweet almonds, and tasteless as olive oil, which it is often used to adulterate, and for which indeed it makes an excellent substitute. It is insoluble in alcohol, but readily saponifies with alkalies.

It possesses the additional advantage of keeping for years without becoming thick or rancid. Upon this latter point, however, the authorities are not all agreed; but there are few dissentients, and the writer, who for many years himself used it under its designation of "teel-oil," for burning in moderator lamps, can bear testimony to its having been invariably sweet and a remarkably limpid and clear oil for burning. In its perfectly fresh state it is largely used in cookery and for various food purposes. It is also applied as a cosmetic and emollient. Both oil and seeds are very fattening; the negro women in the West Indies often drinking the oil for the purpose of making themselves fat. *Hogg* states that the Egyptian women hold the oil in high esteem for cleansing and giving bloom and lustre to the skin, and for preserving the beauty of the hair. As an embrocation to the breasts it is credited with increasing the secretion of milk. At first after manufacture the oil has a gentle hot taste, which, however, soon leaves it.

Evidence of the purity of the oil when properly extracted is found in the fact that it is an excellent medium for extracting the perfume from jasmine, tuberose, orange, and other delicately scented flowers. For this purpose to one weight of flowers are added three weights of oil in a bottle, which is corked and exposed to the sun's rays for forty days; when the oil is found sufficiently impregnated for use either in that form, or for the re-extraction of the perfume by alcohol for the purpose of an essence.

This oil is sometimes confused with "oil of Ben," an error arising from the common name "benne" applied in America to the leaves of the *Sesamum*. The true "oil of Ben" is prepared from the seeds of the horse-radish tree (*Moringa pterygosperma*), hereafter described, and which are known in commerce as Ben-nuts.

Among the Chinese the oil is credited with laxative, cooling, anthelmintic, and other medical properties, and it has been used in ophthalmia and other diseases of the eye; but beyond being considered in its purest form quite equal to olive oil for medicinal purposes, its curative virtues are doubtful. Drury, however, says that a piece of rag dipped in pure sesame oil is considered in India superior to any other simple dressing for ulcers, especially in the hot season.

The soot formed by combustion of the oil is used for the manufacture of Indian ink.

The cultivation of the *Sesamum* is perfectly simple. As soon as the soil becomes sufficiently warm in spring, the seed is thinly sown in drills, and the crop is harvested three months afterwards, weeding being the only cultivation required. Any ordinarily moist soil will suit for the crop, which may be grown at low or high levels. In the Punjab and Kashmir it is frequently seen at an elevation as high as 5,000 feet. That the crop is suited to a dry climate is evidenced by the fact that in Bengal *Sesamum Indicum* is sown in February and the crop is got in three months afterwards; so that, according to Roxburgh, the dews and the little remaining moisture of the earth are the only sources of humidity by which it can benefit, as this is generally a period of drought.

The plant sends up a four-cornered stalk from two to four feet high, according as the soil is poor or rich, with a few lateral branches. The long oval leaves are somewhat hairy and grow opposite. The stalks terminate in loose spikes of small flowers, white or rose-coloured, in shape like those of a foxglove. Apart altogether from its commercial value, it makes a charming garden plant. The fruits are four-cornered capsules, two-valved, about a quarter of an inch long. The seeds are about the size of linseed, but, though flattened and oval, are not so thin at the edges as linseed. As soon as the seeds are ripe the stems are cut and sun-dried, and the seeds are threshed out in the ordinary manner adopted for rape and other seeds.

There is much difference in the colour of the oil, entirely due to the mode of preparation. When the seeds are thrown into the mill without first undergoing a cleaning process, the oil becomes mixed with a portion of the colouring matter of the outer skin of the seed, and is much inferior to that obtained after repeated washing of the seeds in cold water, or by boiling them for a short time until the whole of the colouring matter is removed and they become white. After this they are dried in the sun, and the oil obtained is of a very pale straw colour, with an agreeable odour, and fetches the best price.

The yield of oil is very large, varying from 40 to 45 per cent.—a fact which, taken in conjunction with the excellent quality of this product of the plant, together with the numerous uses to which it can be put, renders the Sesamum one of the most valuable oil-yielding plants of the world.

The residuum, after the expression of the oil, is applied to many purposes. It is universally used as food for cattle, and in some parts of India it forms, when mixed with flour, an article of food among the poor. In Egypt, mixed with honey and preserved citron, it is regarded as an article of luxury. The cake is also recommended as a food for bees, but I do not find in what way it is prepared for this purpose.

The seeds have a warm taste not unlike that of weak mustard seed, and are slightly sweet. In medicine they have powerful emmenagogue and diuretic properties assigned to them, although said to injure digestion; and they are used in many forms for food purposes. They enter in various ways into Eastern confectionery, but principally for strewing on cakes to impart to them a nutty flavour. They are eaten parched; and in this form, also, are

used as a substitute for coffee, or as an adulterant of cocoa. Sesamum flour, either with or without other ingredients, is made into bread, cakes, and puddings; and Lunan tells us that the so-called "mandarin broth," mentioned by writers on China, is only an emulsion of sesamum seed in hot water. The meal is also used for the various medicinal purposes to which linseed is put, to which it is considered superior.

The officinal value of the Sesamum does not, however, end even here. Its leaves, fresh or dry, abound in mucilage, which is readily imparted to water. Two or three fresh leaves soaked in a tumbler of cold water render it viscid, and the emulsion thus made is a popular domestic prescription for bowel disorders in children, and, in fact, for all affections requiring mucilaginous drinks. If the dried leaves are used, hot water must be substituted for cold. The fresh leaves also make good emollient poultices.

Large quantities of sesamum seed are brought to England from the West Indies, Egypt, Africa, and sometimes from Brazil, the market value varying from £25 to £18 a ton; and there is no reason why Queensland should not send her contribution. The crop is easy to grow, and there is a ready market for the first product in the form of seed; while to the more enterprising it will yield its oil by a simple process and at little cost.

GINGER.

(*Zingiber officinale.*—ZINGIBERACEÆ.)

It is difficult to fix the original habitat of the Ginger plant, although it is known to be indigenous both to the East and West Indies. The root is tuberous, of a somewhat flattened roundish form, marked with rings; when young, it is externally of a white colour, internally soft and of greenish colour. When it gets older it becomes grey outside and reddish internally, while the texture becomes fibrous. The best ginger is the white, and should be of firm texture, free from wormholes, and heavy; that which is light and friable is bad. The so-called "black" is less aromatic, its properties being impaired by its being prepared by scalding in boiling water.

Ginger is largely produced for the market in many warm countries, the West Indies (British and French), the East Indies, and the west coast of Africa all being large exporters of this staple product; China and Japan also produce large crops for home consumption. The white varieties most in demand are Jamaica white, Barbadoes, African, and East Indian. The best "black"—which by the way is a misnomer, the colour being in fact a dirty stone—is "Jamaica Black," and "Malabar Dark."

There are sundry varieties of the plant in question, distinguished by the breadth of leaf, size of tuber, and height of growth; and there are other plants, to which it is not necessary to refer, the roots of which have similar properties, and which are more or less used for the same purposes as ginger.

The crop is simple of cultivation, and no one in localities where it will grow need be without his ginger patch for home use. The soil should be good and heavy, light sandy soil being unsuitable. Land which has been previously cultivated for a green crop, and is in good heart, answers well for ginger.

In the early spring the ground must be trenched, and beds from three to four feet wide be prepared. It is all the better if the land has been manured for a previous crop, as in the case of potatoes. In these beds small holes are opened about twelve inches apart, and are filled with well.

rotted manure. Good clean sets of ginger root, free from decay, and from one to two inches long, are then placed in the holes, at a depth of not more than three inches; and the whole bed is covered up with a thick layer of leaves which answer the double purpose of keeping off the wet in case of unusual rain, and of manure. In this country suitable leaves may not be available, and rotted dung will answer well. This is a point, however, which the intelligent grower, knowing the object to be attained, will soon settle for himself. Care must be taken that the material used is not a breeder of worms, which, if abundant, interfere much with the success of the crop. Although ginger insists upon moisture during its growth, it is impatient of the lodgment of water; and care must therefore be taken that the drainage is good. For a large crop it may be necessary, should the rainfall be insufficient, to resort to some method of irrigation; but upon the small scale for domestic use, the watering-pot can easily supply the necessary moisture, as the superincumbent layer of manure or other vegetable matter prevents rapid evaporation.

A good crop yields four times the weight of the sets planted, and takes about six months to mature. When the leaves and stalks die down the crop is fit to dig. In the Himalayas it is successfully grown at an elevation of from 4,000 to 5,000 feet.

Black ginger consists of the mature roots, without selection, scalded and dried. For making white ginger the best roots are selected, and this form is therefore superior, apart from the method of preparation. They are carefully scraped, without being scalded, and are dried, being often subjected to a further process of bleaching with chloride of lime.

Oil of Ginger is obtained from the tubers by aqueous distillation. It is yellowish, very thin, smells strongly of ginger, and tastes burning and aromatic.

For converting into a preserve, the roots are taken up as soon as they are formed, when still young and tender. This will vary somewhat according to the season which follows planting, but will be at somewhere about two months old, when the stalks are not more than five or six inches high. The tubers in this state are scalded, washed in cold water, and peeled clean. The water in which they are washed is frequently changed, and this process lasts three or four days. A syrup is then made of a pound of sugar to a pint of water, into which the beaten whites of two eggs are gradually stirred. This syrup is then boiled, and carefully skimmed, and, when quite cold, it is poured on to the tubers. After two or three days the syrup is poured off, reboiled and skimmed, and when cold poured over again, and the whole is left for three or four days. The next process is to reboil and reclarify the syrup, which is then for the first time applied *hot*. If necessary the process is repeated until the syrup has well penetrated the ginger, which is evidenced by the taste and transparency of the tuber, and until the syrup becomes very thick and rich. The syrup must not be applied hot in the first instance or the ginger will shrink and shrivel. In India the weak syrups after being poured off are not used again, but are fermented and make a pleasant drink.

The process of candying is simply that of drying the ginger, preserved as above, a little dry powdered sugar being used to aid the drying.

The following is the specification of a Melbourne patent for "*Ginger Champagne*":—To manufacture sixty gallons, there are first placed fifty-eight gallons of cold water in a copper boiler, to which are added one hundred and fifty-eight pounds of the finest raw sugar and five pounds of bruised ginger. The mixture is then heated and allowed to boil gently for about half-an-hour, during which time the scum rising from the surface must be

taken off. After this has been done the liquor must be drawn out of the boiler and placed in coolers, and after the temperature has been reduced to about blood-heat, it is placed in casks in which the following articles have been previously put—namely, thirty-six pounds of raisins cut into small pieces, six dozen of oranges, and six dozen of lemons, sliced thin. There must then be added to the liquor in the casks one quart of yeast, which with the liquor is allowed to ferment. After the fermentation has ceased, there is added to the liquor one gallon and a-half of proof spirits and six ounces of isinglass. For the purpose of fining the liquor eggs may be substituted for the isinglass, which, however, is preferable. The whole is then mixed well together, and the cask fastened up for about one month, when it is racked off into another cask, and bottled, being then ready for the market."

The following receipt for making "ginger-beer" has high medical authority as yielding a very superior beverage, and one which will keep many months :—White sugar, 20 lbs. ; lemon or lime juice, 18 fl. oz. ; honey, 1 lb.; bruised ginger, 22 oz. ; water, 18 gals. Boil the ginger in three gallons of water for half-an-hour, then add the sugar, the juice, and the honey with the remainder of the water, and strain through a cloth. When cold add the white of one egg and ½ fl. oz. of essence of lemon ; after standing four days, bottle. The bottles are to be laid on their sides in a cellar, and the beer is ready for use in about three weeks. If a little yeast be used the beer is ready in a day or two ; but in this case it does not keep well.

Ginger-beer powders are made as follows, viz. :—White sugar, 2 oz. ; bicarbonate of soda, 26 grs. ; powdered ginger, 5 grs. ; essence of lemon, 1 drop ; mix and put in white paper ; in blue paper put ½ oz. of tartaric acid. In drinking use in exactly the same way as a seidlitz powder.

Ground ginger is the subject of adulteration to a large extent ; wheat flour, ground rice, potato flour, sago, turmeric, mustard husk, and cayenne pepper being all used for the purpose of fraudulently cheapening the article for the vendor, and proportionately reducing the value for the consumer. The microscope, however, lays bare the fraud, and with its aid there is little difficulty to the practised microscopist to discover which of the adulterants have been used, and to what extent.

As the value of ginger for medicinal and flavouring purposes is greatly reduced by these admixtures, it is of course best to use the root in all cases ; pounding in a mortar, grating, or macerating as may suit the purpose in hand.

Pereira describes the physiological effects and uses of ginger as follows :—" Ginger is one of the aromatic stimulants which possess considerable pungency or acridity. Its dust applied to the mucous membrane of the nostrils acts as an irritant and provokes sneezing, The rhizome chewed powerfully increases the flow of saliva. The powder mixed with hot water and applied to the skin causes a sensation of intense heat and tingling and slight redness. When taken into the stomach ginger operates as a stimulant—first, to the alimentary canal ; secondly, to the body generally, but especially to the organs of respiration. Like some other spices (the peppers, for instance), it acts as an excitant to the genital organs. Furthermore, it has been said to increase the energy of the cerebral functions. It is less acrid than pepper.

"Its principal consumption is as a condiment. Its powers in this way are considerable, while its flavour is by no means disagreeable, and its acridity scarcely sufficient to enable it, when taken with food, to irritate or inflame.

"As a *stomachic* and *internal stimulant* it serves several important purposes. In enfeebled and relaxed habits, especially of old and gouty individuals, it promotes digestion, and relieves flatulency and spasm of the stomach and bowels. It checks or prevents nausea and griping, which are apt to be produced by some drastic purgatives. It covers the nauseous flavour of many medicines, and communicates cordial and carminative qualities to tonic and other agents. As a promoter of saliva, it is sometimes chewed to relieve toothache, relaxed uvula, and paralytic affection of the tongue. As a *counter-irritant,* I have frequently known a *ginger plaster* (prepared by mixing together powdered ginger and warm water, and spreading the paste on paper or cloth) relieve violent headache when applied to the forehead. *Powdered ginger* may be administered in doses of from ten grains to a scruple, or more, in the form of a pill. Made into a paste with hot water it may be applied as a *plaster*, as already mentioned. *Preserved ginger (Conditum zingiberis)*, though commonly used as a sweetmeat, may be taken with advantage as a medicine to stimulate the stomach. *Ginger lozenges* and *ginger pearls,* commonly termed *ginger seeds* and *ginger pipe,* are useful articles of confectionary, which are frequently of benefit in dyspepsia accompanied with flatulence."

Ginger tea has been recommended in gouty cases. Begin with a heaped teaspoonful, taken in boiling milk, either for supper or breakfast. The quantity may be increased to two or even three drachms. Sir Joseph Banks gave the following account of its effects upon himself in 1784:—"I have taken two teaspoonfuls heaped up, of ginger powder, in a pint of milk, boiled with bread, and sweetened with sugar, for breakfast, for more than a year past. The weight of the ginger is between two and three drachms. At first, this quantity was difficult to swallow, if the ginger was good. I was guided in the quantity by the effect it had on my stomach; if it made me hiccough the dose was too large. I found occasionally that it produced *ardor urinæ;* but this went off without any ill consequences whatever. I have not yet found it necessary to increase the dose; but I use rather a coarser powder than I did at first, which mixes more easily with the milk, and probably produces rather more effect than fine. The late Lord Rivers took ginger in large doses for more than thirty years; and at eighty was an upright and healthy old man. I have, since I used the ginger, had one fit of the gout; but it was confined entirely to my extremities, and never assailed either my head, my loins, or my stomach, and lasted only seventeen or eighteen days; but the last fit I had, before I took the ginger, affected my head, my stomach, and my loins, and lasted with intervals from the end of October to January."

"In estimating the quality of ginger," says Hassall, "a variety of particulars have to be taken into consideration as to whether the rhizomes are coated or uncoated, their form, colour, and consistence. The rhizomes of ginger of *good quality* have no epidermis, are plump, of a whitish or faint straw colour, soft and mealy in texture, with a short fracture, exhibiting a reddish, resinous zone round the circumference; the taste should be hot, biting, but aromatic. The rhizomes of ginger of *inferior quality* are frequently coated with the epidermis, are less full and plump, often contracted and shrivelled; of a darker colour, being of a brownish-yellow; of harder texture (termed *flinty*), and more fibrous; while the taste is inferior and less aromatic."

GUACO.

(*Mikania Guaco.*—COMPOSITÆ.)

In a country like Queensland, where venomous snakes abound and fatal cases of snake-bite periodically occur, it becomes important that any remedies should be made known which can be kept available at a moment's notice, and are simple and innocuous in their application. For this reason I include in this series of papers a plant about which not much is known except that there is attributed to it the virtue of being a sure antidote to snake-bite.

To Dr. Schomburghk, the Director of the Adelaide Botanic Gardens, is due the credit of having introduced this plant, from purely philanthropic motives, into Australia, and of having distributed it to Queensland among other places. It belongs to a class of tropical plants which are mostly climbers; this species with a few others being an erect undershrub. Indeed, in the writer's experience of this plant, it never gets off the surface of the ground at all, being in appearance not unlike a chrysanthemum before the stems grow.

Although the plant has been for some years in Queensland, and has been largely distributed, I am not aware if its peculiar virtues have ever been practically tested. Very little has been written about the Guaco, but what there is comes with high authority.

The meaning of the term "guaco" is not traceable, and the word is probably taken from the peasant vernacular of Spanish America.

The authorities of Kew, ever desirous of promulgating useful information, a few years since sent, all over the world where poisonous snakes are found, a printed slip, with the following information taken from the "Pharmaceutical Journal" of 6th November, 1880; to which Journal, however, as will be seen, they had themselves in the first place furnished the information :—

"THE MIKANIA GUACO AS A REMEDY FOR SNAKE-BITE.

"In South America, under the name of "guaco," several plants enjoy a considerable reputation as remedies against snake-bites. Most of them are species of *Aristolochia*; but one, the Mikania guaco, is a composite plant. Notwithstanding this reputation, very little trustworthy evidence has been published as to the real efficacy of any of them, and an attempt made by Dr. Schomburghk a few years since to introduce the Mikania guaco into South Australia, with a view of clearing up the doubt, does not appear to have led to a definite result. In a letter, however, recently received by the Director of the Royal Gardens at Kew, from Mr. Robert B. White, of La Salada, New Granada, the writer gives his personal testimony as to the value of the remedy, and some other information which, by the courtesy of Mr. Thiselton Dyer, are made available for the readers of this journal.

"Mr. White says that the Mikania guaco is the true 'guaco,' and forms the basis of all the preparations of the snake-bite doctors of the district. There are two varieties—one with green stems; the other, called "morado," with purple, the latter being the most prized. There are several species of snakes in the country whose bite is deemed mortal, some of them killing in a very few hours; but Mr. White, who has lived in the Choco and other snake-infested regions many years, testifies that the guaco, properly and promptly administered, is a cure for the bite of the most venomous.

"In cases of snake-bite, when the guaco leaves can be obtained fresh, an infusion in sugar-water is made, in the proportion of one leaf to a large cupful, and this quantity is given hot every hour. It is said to stop the vomiting usually occurring. The leaves are also preserved by bruising and placing them in alcohol, and of the tincture thus formed a teaspoonful is administered every half-hour for one hour and a half, and then every hour,

and afterwards the dose is gradually diminished. Hot poultices of the bruised leaves and stem of the plant are applied to the wound, taking care not to use sufficient heat to drive off the volatile principle of the plant. If there be swelling and pain the limb is fomented with hot water to which some tincture of guaco has been added.

"The Mikania guaco is described as growing from seed in any good soil where there is a temperature of 24 deg. to 25 deg. C., and it would appear to be a plant deserving of physiological and chemical experiments to determine its true character. It is worthy of note that it was at one time said to be the source of condurango."

Lindley and Moore give the following account of Guaco :—

"In Central America one or more plants called Guaco by the natives are held in high esteem for the cure of snake-bites. It is conjectured, with much probability, that the Guaco is some species of *Aristolochia*. So satisfied are the natives of Peru, Central America, and Mexico of its extraordinary medicinal powers and specific virtues, in cases of snake-bites, that every Indian or negro who has to traverse the country invariably has a supply of this friendly plant in a dry or prepared state to meet any accident that may befall him by inadvertently placing his foot upon one of these dreaded and deadly foes of mankind. Mr. Temple, to whose account of this plant published in the "Journal of the Society of Arts" for the year 1855 we are indebted in drawing up this notice, states that he employed the tincture in four cases of snake-bite with complete success. He also gives a strange account of the way in which the Guaco is reported to have been first discovered, the substance of which is as follows :—A traveller, passing through a forest, observed two formidable snakes engaged in a deadly encounter; after a short time one was severely bitten and fled from the scene of conflict until it reached a creeping plant the leaves of which it partook with greediness—that plant was the Guaco. He secured the reptile, and brought away the plant, the leaves of which it had eaten. The snake, although bitten by one of a most deadly species, quite recovered. Another report, as probable as the other, is that snakes have been observed carefully to avoid localities where the plant grows. Many persons are so firmly persuaded that the snake will not approach the Guaco, that when travelling in the bush they carry a small piece of the root of the plant in their pocket. So, then, this wonderful plant prevents the access of snakes, stupifies them and kills them if they do come, and cures them if bitten by a fellow-snake, and likewise cures human beings bitten by these venemous reptiles. There can be no doubt of the partial truth of some of these statements, and hence not only the botanical history but the medical properties of Guaco demand accurate investigation."

The medical properties of *Mikania guaco* are not confined to its being an antidote to snake bite, as it is stated to be used in South American medicine for the relief of paroxysms of gout, and as a powerful febrifuge.

The question whether the true "guaco" was a *Mikania* or an *Aristolochia* is set at rest by the paper promulgated by Professor Dyer; but the roots of several of the *Aristolochias* are used in the Southern States of America as a remedy for snake-bite, notably that of *Aristolochia serpentaria*, the "Serpentary" or "Virginian Snake-root," which is said to be a cure for the bites even of rattlesnakes and mad dogs.

Another root, also a native of the States, is used for similar purposes, namely, the "Seneka-root," or, as it is also called, the "Seneka Snake-root," or the "Rattlesnake-root." I do not think that either of these roots have been introduced to Queensland, but the subject is worthy of the attention of the Acclimatisation Society.

GUM-ARABIC.

(*Acacia Arabica.*—LEGUMINOSÆ.)

The *Acacia Arabica* is taken as the text for the subject of Gum-arabic, because, although by no means the chief source of supply of the staple product, it is one of the principal trees from which the East Indian gum is obtained, and has been widely distributed in Queensland. The most productive species is the Egyptian *Acacia vera* or *Nilotica;* but gums of close resemblance to gum-arabic are obtained from *Acacia Seyal, A. Adansonii,* and others. I shall not dwell upon this branch of the subject, especially as botanists do not commit themselves to clearly define the species, and as it is not improbable that the *Acacia Arabica* of my paper is identical, or nearly so, with the Egyptian *A. Nilotica;* and that the difference in the quantity and quality of the gum is the result of climate.

The *Acacia Arabica,* the "Babul" of India, of which handsome fruiting specimens may be seen in some of the gardens on our northern coast, is a tree which delights in a strong black soil, and which grows rapidly if irrigated. It possesses, however, the advantage of resisting drought better than most trees, and of accommodating itself to almost any soil; its rate of growth and the size which it attains being naturally governed by the conditions under which it grows. It is a tree which is never leafless, and attains a height of 60 feet, with an irregular trunk 10 to 15 feet long and 5 to 6 feet in girth, the latter increasing under favouring conditions to as much as 12 feet. Its spreading habit and dense foliage make it a handsome umbrageous tree. In India it is by no means confined to the plains, being found up to an elevation of some 3,000 feet, after which it disappears. The tree propagates freely from seed, but like many of the acacias it does best if the seed is sown where the tree is to grow. When young it sends down a long taproot, and thrives on both light and heavy soils. If kept thinned it makes a good hedge, for which purpose it is sometimes used. It is found in every district of India, north and south, and is cultivated for various purposes, the gum, bark, timber, and pods being all used. These latter are a favourite food with sheep and goats.

"Gum-arabic" is a general trade name for several descriptions of clear soluble gum. There are three leading sorts:—"Elect," which is the finest white gum; "common," which is darker; and "gum siftings," which consist of the very small particles of both, whether actually so or the result of packing, separated by sifting.

The African gums are divided into no fewer than thirty-two grades, varying in value per ton weight from £140 to £35. As an illustration of the immense trade in gum-arabic, it may be mentioned that in August, 1880, at Trieste, the stock on hand of African gums of all grades amounted to 900 tons.

The East India gum is a very dark variety, generally supposed to be the produce of the tree under description, but much of it comes from *Feronia* * *elephantum,* a member of the orange tribe. Other trees, however, contribute to make up the staple commodity, among which may be mentioned the Mango, *Spondias mangifera,* a species of *Albizzia* and *Mimosa, Terminalia bellerica, Melia,* and the *Cashew nut. The gum from this latter tree possesses the valuable qualities that it never cracks nor will insects eat it. For these reasons it is especially useful for the purposes of the herbarium.

In the Southern States of America the gum of peach, plum, cherry, apricot, and other gum exuding trees is used in place of gum-arabic to increase the brilliancy of starch and in sealing envelopes. For mucilage in medicine an infusion is made of the leaves of **Sesamum orientale,* one of the

* See ante.

oil seeds—an annual plant, well adapted to our climate. By no means the least important use to which these clear gums are put in India is that of food, especially in times of scarcity, and as far as the supply goes it is nutritious and wholesome.

In 1740 an Abyssinian caravan travelling to Cairo ran short of provisions when they had still two months' journey before them. By good fortune they had with them as merchandise a considerable quantity of gum-arabic, and this served as the main support of a thousand persons for two months, the caravan arriving at Cairo without any serious diminution of their numbers.

After the rainy season the gum exudes spontaneously from both trunk and branches of the tree, flowing in a liquid and thickening either in a worm-like shape, or more commonly in round or oval tears, form and colour varying in different trees. The hotter the weather, and the more sickly the tree, the greater is the yield of gum. It will be of course well known to your readers that many of the Australian acacias also produce gum, and the writer has seen old specimens of the green wattle, in the last gasp of life, with the bark thickly covered with large clusters of gum. A wet winter and cool summer are unfavourable to the production. In Senegal, whence much of the very best gum of commerce comes, the gum begins to flow when the tree first flowers in spring, and continues through the rainy season, at the end of which, in December, it is collected for the first time. A second gathering is made in March from incisions, which are rendered necessary by the extreme dryness of the air at that season.

The heart timber of *Acacia Arabica* is of a pale-brown colour, close-grained and tough, and is put to many uses for building, for spokes and felloes, axles and naves, mallets, ploughs, railway sleepers, sugar-cane rollers, ships' knees, etc.; but it cannot be obtained of a large size and is generally crooked. It makes excellent charcoal, and is one of the best fuels for locomotives, for which purpose it is largely used. In many parts of India, where the tree is scarce, it is largely planted by the Forest Department for the special purpose of fuel. In some districts, however, it is wonderfully abundant; pure forests of "Babul," of the extent of 27,000 acres, existing in Sind.

The pods are used for tanning, and when unripe, in combination with an iron salt, make an excellent ink. The bark is extensively used both for dyeing and tanning, being powerfully astringent and imparting to the leather a reddish colour. It is also used medicinally as a tonic.

As exemplifying the value of the bark for tanning purposes, the following extract from Baker's Diary, in his "Nile Tributaries," will be interesting:— "August 27.—My antelope skins are just completed, and are thoroughly tanned. Each skin required a double handful of the "garra," or fruit of the *Acacia Arabica*. The process is simple. The skin being thoroughly wetted, the garra is pounded into a paste; this is rubbed into the hide with a rough piece of sandstone until it becomes perfectly clean and free from impurities; it is then wrapped up with a quantity of the paste, and is deposited in a trough, and kept in the shade for twenty-four hours. It should undergo a similar rubbing daily, and be kept in the trough to soak in the garra for four or five days. After this process it should be well rubbed with fat, if required to keep soft and pliable when wetted. If soaked in milk after tanning, the leather will become waterproof."

HOG-PLUM.

(*Spondias mangifera.*—ANACARDIACEÆ.)

More than one species of *Spondias* is known by the inelegant vernacular, "hog-plum." That in question is a native of India, in dry forests, Burmah, and Ceylon, where it has sundry designations, according to the dialect of each district where it is found, all having the same meaning—" wild mango ;" but none of them will be familiar to the reader or so generally descriptive as that chosen. In Northern India it is a small tree not exceeding 25 feet in height and 4 feet in girth ; but in Southern India and Ceylon it attains a much larger size, in the latter country being found from the plains up to an elevation of 3,500 feet above sea-level. It is deciduous in habit, being one of the first trees to shed its leaves, and the last to renew them ; a habit fully borne out by a specimen at Bowen Park. This specimen, which was received from Bombay about eight years ago, is now about 20 feet high, but has never flowered. The climate seems to agree with it well, as it clothes handsomely with foliage each year, and shows no sign of suffering from cold. As regularly as the growing season comes round, however, the young foliage is injured by a grub which is hatched at the terminal point of the tender shoots and bores its way down for some distance, naturally to the injury of the tree. Much the same sort of bar to growth is to be seen in the case of yound red cedars, which are often kept stunted from this cause, when all the other conditions are favourable to robust and healthy growth.

The tree is a robust grower, with foliage not unlike that of the walnut. The oval-shaped fruit, which attains the size of a goose-egg, is of a rich olive green somewhat mottled. with a slight scent, but nothing like the perfume of its ally, the vi-apple. Unripe, it makes excellent pickles ; and when quite ripe the part nearest the stone is sweet and pleasant, but as the flesh approaches the rind it becomes acid. That it is not held in high esteem in India, where luscious fruits abound, affords no reason why it should not be grown in Queensland ; but it may be hoped that the specimen at Bowen Park will soon afford the public an opportunity of judging for themselves of its qualifications.

The wood is soft, coarse-grained, and useless ; but from the bark a mild insipid gum exudes, similar in character to gum-arabic ; and this is collected and sold. A characteristic of the tree which may assist to identify it is a peculiar smell emitted by the mature foliage when rubbed.

Another species, *Spondias lutea*, a native of the West Indies, has more than once been introduced into this colony, but has, I fear, been lost. Decoctions of the bark and leaves of this species have decided curative virtues, applied both internally and externally, both for man and horse. Dr. Barham narrates a cure effected by the aid of the bark of this tree, in a case of swelling and violent inflammation of the legs after fever. It was suggested by a negro, who asserted with confidence that he could effect a cure. As Barham was the patient, and was himself an able physician and skilful naturalist, the statements may be implicitly believed. The tree would thrive on the warm bottom lands of our northern rivers, and is well worth introducing again.

HORSE-RADISH TREE.

(*Moringa pterygosperma.*—MORINGACEÆ.)

This tree is indigenous to the East and West Indies, South America, Mauritius, and Java, and is naturalised in Southern Europe. Its timber is soft and useless, of no value even for fuel. The uses of the tree are, however, manifold in the various countries in which it is indigenous.

Its common name is derived from the circumstance that the root possesses the flavour and properties of horse-radish, being hardly distinguishable from that esculent. It possesses to a high degree also the same stimulating properties, whether used internally or externally; and is also a sudorific and diuretic. As an external application it is valuable to produce irritation where blisters would prove injurious. The various parts of the tree, whether roots, bark, or leaves, are indeed largely used, by the natives of some of the countries where it is indigenous, for almost every ailment that human flesh is heir to.

The long handsome pods, before they are ripe, are a capital addition to curries, and plain-boiled they are hardly distinguishable from asparagus. For this latter purpose, however, they must be gathered quite young; otherwise, like the okro (*Hibiscus esculentus*) of the West Indies, they soon become too fibrous.

The principal value of the tree is for the oil contained in the ripe seeds, constituting the "oil of Ben" of commerce. This is inodorous, clear, and nearly colourless, and possesses the remarkable properties of keeping for years without becoming rancid, and of not congealing under the influence of cold. In the West Indies these qualities lead to its being used for salads in place of olive oil. For watchmaking and other fine purposes, for which a lubricator is required which does not clog, oil of ben is invaluable.

The oil is fluid at 25°, thick at 15°, whilst at lower temperatures it vaporises slowly.

Its purity gives it especial value for extracting the perfume from flowers by the "enfleurage" process. The method of using it in this way is thus described: "Dip some fine carded wool in the oil, on this spread a thick layer of fresh flowers, above which more cotton, dipped in the oil, is placed; and so on, alternate layers of cotton and flowers, till the vessel containing them is full. The vessel must then be made thoroughly airtight, and be set in a water-bath to digest for twenty-four hours, when the oil, having extracted the odour of the flowers, is expressed from the cotton, and sold by the perfumers as the oily essence of the flowers with the perfume of which it has been impregnated."

The leaves and flowers are eaten by the natives, and the twigs and leaves make an excellent fodder where grass is scarce. The seeds also are eagerly eaten by sheep. A gum, resembling "Tragacanth," exudes from wounds in the bark, but this product of the tree is not considerable. The wood yields a blue dye.

The horse-radish tree is easily raised from seed, and is of rapid growth. Being moreover a tree of pretty habit, its qualifications may be fairly considered sufficiently varied to justify a place for it in Queensland gardens.

It is stated to be used in Jamaica for fences; but the habit of the tree certainly does not fit it for that use as the word "fence" is understood here. It is probable that the term is used to denote divisions between the different parts of a garden; and for this purpose its light foliage and manageable habit adapt it admirably.

INDIGO.

(*Indigofera tinctoria; I. anil; I. argentea, &c.*—LEGUMINOSÆ.)

The "Indigo" of commerce is the product of several species of the genus Indigofera, of which the principal is *I. tinctoria.* The number of species, all more or less containing indigo, is very great, and they are widely spread over the East and West Indies, America, Australia, Africa, Arabia, &c. In extra-tropical Africa alone, Baron Mueller states there are 114 species recorded; but very few of all the known species have been tested for the colouring principle.

The word "indigo," or, as it used to be called "indico," is derived from the ancient name of the dye "indicum," evidently denoting its having been a production of India, although long after its introduction into Europe it was generally unknown what the substance was. Its interference with "woad," a blue dye obtained from *Isatis tinctoria,* a plant forming the basis of a considerable industry in many parts of Europe, led to strong prejudice against its use; the opposition going so far, in the sixteenth and seventeenth centuries, that prohibitions were issued and were vigorously enforced against its use. Its undoubted superiority over woad gradually, however, led to a relaxation of these restrictions, until the native article was by sure degrees supplanted by the foreigner. As the use increased, America entered into competition with India in the production of indigo to an extent which eventuated in the manufacture of the Indian staple being greatly reduced. Various causes, unnecessary to advert to here, led in turn to the cultivation in America falling off, until the balance of production in favour of India was again restored. India is now the chief source of supply, but considerable quantities are produced in Central and Southern America, the Philippine Islands, the South of China, the French West Indies, the Delta of the Nile, the West Coast of Africa, &c.

The different species vary in habit and form. Some are annual, others perennial; some, as in the case of those at our own door, are low-growing, tender-looking plants, while others are woody shrubs. *Indigofera tinctoria* is a shrubby plant, growing from 3 to 4 feet high, with oval leaflets and long narrow pods. *I. anil,* the next in importance of cultivation, and known as the West Indian indigo, attains a height of 5 or 6 feet, with leaflets shaped like the spathula of the chemist, and its pods are short and thick. *I. tinctoria* has a root a quarter-inch thick, and from 1 foot to nearly 3 feet long, indicating the necessity for a deep soil, and the capability of the plant for resisting drought; and has a faint smell like parsley. The seed of both species is small, like coarse gunpowder.

Of all the species of *Indigofera* from which indigo is made, Dr. Roxburgh gives the palm to one which he calls *I. cœrulea,* an erect, shrubby species growing in barren soil to the height of three feet, with a woody stem as thick as a man's thumb—a biennial or triennial species. He makes this species to come near to *I. argentea,* but Dr. Brandis, a more modern Indian authority, thinks the two probably identical. Roxburgh says of this plant—"From its leaves I have often extracted a most beautiful light indigo, more so than I ever could from the common indigo plant, or even from *Nerium tinctorium,** and in a larger proportion. After an enquiry of nearly two years, I have not been able to discover that the natives of any part of India make use of it. The process by which I obtained the colour from the leaves was exactly similar to that for obtaining the indigo from the leaves of *Nerium tinctorium,* viz., by committing them, while fresh, to cold water, and

* This plan is referred to more fully hereafter.

scalding them over a moderate fire to about 160° of Fahrenheit's thermometer. The liquor will then have attained a beautiful deep greenish-yellow colour; it is then strained off clear, and while hot is gently agitated in a broad, shallow, open vessel for from 20 to 30 minutes. During this time it changes colour, gradually becoming darker and darker and more turbid. When sufficiently agitated, if a little of it be viewed in a clean silver spoon, or any other vessel that reflects the light, a muddiness, or minute grain, may be easily seen, which is rendered large and copious by the addition of a little lime water. This fecula readily falls to the bottom, the superincumbent liquor is then poured off, and will be more or less of a clear brandy colour, according as the operation has been successfully conducted; for the more the liquor is tinged with green, the less perfectly has the colour been separated, and the produce is, of course, the more deficient and less beautiful. How to effect the most perfect separation and precipitation of colour is the grand desideratum with our indigo manufacturers, and well deserves the chemist's most serious attention."

Indigo prefers a rich loamy soil, not too dry, with a warm exposure. Such soils are more easy to cultivate, but it will succeed in any well-drained soil, so long as it is rich—not refusing even clays; but heavy land is open to the objection that it is difficult to cultivate and to get the plant out of the ground again. There are various methods of culture, but the more the ground is tilled the better. The seed is sown in Spring, when there is no longer any chance of frost. Some sow broadcast 35 to 40 lbs. of seed to the acre, harrowing in, and, if possible, rolling it afterwards. Other cultivators sow in holes 3 inches deep and 2 feet apart on good soil, and 10 inches apart on poor; others again 2 inches deep and 5 or 6 inches apart. Another method is to open drills 2 to 3 inches deep, and 12 to 14 inches apart, a peck of seed being used to the acre. It is a very common fallacy, which has come under the observation of the writer, and to which Porter makes marked allusion, for tropical agriculturists to burden the soil in proportion to its disability of supporting vegetation. It is obvious that the contrary practice should be pursued, as very little consideration will make it clear that the fact of the soil containing little nutriment affords no reason for crowding the plants close together, and thus overtaxing its deficient resources. In favourable weather the plants will appear in a few days, when young being hardly distinguishable from lucerne; but should rain intervene and the soil become caked before this happens, it will be well to break the crust by a light raking with a horse or hand rake. Until the plants flower, which is the period of cutting, and takes place in from three to four months, the ground must be kept free from weeds; a process much facilitated by the drill system of sowing. As soon as the crop is in flower, and before there is any sign of falling off in vigour, the plants are cut, the colouring matter being most plentiful when that stage has been attained under abundant sunshine. If rain has been abundant and sun deficient the crop will be larger, but at the expense of quality, for the purpose of the manufacturing process.

Crawford in his "Indian Archipelago," speaks thus of the cultivation of indigo in Java:—"Of the common indigo plant, besides the wild kind, there are in Java, where the plant is best known, three cultivated varieties; the practical difference between which, as among the other great objects of husbandry, consist in the size of the plant, and the shorter or longer time it takes to come to maturity. Indigo, in Java, is either raised as a second crop after rice in low lands, or in upland soils as the principal crop; in both cases it is reared without the assistance of dressings of any sort. It is remarkable that in the hot plains the indigo plant seldom comes to seed, and that the little which it yields is of a bad kind. Though the plant, therefore, be cul-

tivated in the plain for the purpose of manufacture, the seed is raised in elevated or hilly tracts, which proves that in its physical distribution it is not an inhabitant of the climate of the plain but of a more elevated region. According to the practice of the natives of Java, indigo is sown about the middle of July, and the first crop is cut in two months. The manufacturing season continues two months, and the plant is cut, in all, three times. The native process of manufacturing is extremely rude. The stalks and leaves having lain for some days to macerate, are then boiled, and afterwards mixed with some quicklime and fern leaves to fix the colour. In this semi-liquid state it is applied to use, and large quantities of it are so exported by the Javanese to their ruder neighbours. The practice of manufacturing the pure *fecula* into a solid mass is unknown to the natives. Of all productions called colonial, indigo is the one which demands, in the manufacture, the largest share of intelligence and judgment. None of the Asiatic nations are equal to the manufacture of a perfect drug, fitted for the market of Europe. The Chinese, who can manufacture sugar, cannot manufacture good indigo, which is the peculiar product of the skill and civilisation of Europeans.

There is a difference of opinion as to the height—from 1 inch to 6 inches—at which the plant should be cut; the object to attain, in determining this, being to induce the best crop of ratoons for a second cutting. After a little experience, Queensland growers will have no difficulty in determining this for themselves. Although the crop is credited with having three or four cuttings, the plants rapidly deteriorate, and it rarely happens that a third good cutting is obtainable. It must be sown afresh every year.

In preserving some portion of the crop for seed, the most robust plants should be selected, from which the pods are gathered when fully matured. Ten bushels of pods are stated to yield one bushel of clean seed.

I have already alluded to the fact that the methods of cultivation differ. In the manufacture, also, there are as usual variations according to the experience or opinions of those engaged in the industry.

The dye is not found in the growing plants, but a yellow substance is dissolved out, which by contact with air becomes deep blue and insoluble, and finally precipitates. This worked and carefully dried constitutes the staple article. Nor is fermentation essential, as a mere infusion of the plant in hot water deposits indigo by standing in the air.

Comparing the several methods in use, the following is selected as a plain graphic description, from a perfectly reliable source :—

"The soils best adapted to indigo are rich sandy loams, though it grows on most lands moderately well, provided they are not wet. The ground should be well broken, and kept light and free from grass by the plough. The nature of the manure used exerts a great influence upon the quantity and quality of the colouring principle. Those substances that act as stimulants to vegetation, such as lime, poudrette, ashes, etc., etc., favour the growth of the plant without injuring the colouring matter. When barn-yard manure has been largely used, a crop of grain should first be raised on the land.

"The seed should be mixed with ashes or sand and sown in drills fourteen inches apart, four quarts of seed to the acre. The seed should be sown in the early Spring. When it first comes up it should have the grass picked out with the hand. When an inch or two high the grass between the rows should be cut out with the hoe or scraper and the soil loosened about the roots. Three weedings are enough before the first cutting, which should commence as soon as the plant throws out its bloom. It is so easily injured by the sun after being cut that the operation should be commenced and end in the afternoon. After cutting with the reap-hook it is put under the

shed until it can be put in the vats. In Georgia the two cuttings yielded sixty pounds of indigo to an acre, provided the roots were not injured in the first cutting, which at three acres to the hand would be one hundred and eighty pounds."

Like other plants it has its enemies.* The leaves are frequently seen covered with yellow spots, owing to some change in the atmosphere. It often happens that in consequence of a degree of heat and drought the plant is not fully developed ; the leaves are not more than one-third their proper size, yet exhibit all the properties of a perfect plant. If the plant is cut in this imperfect state the crop is lost, for the indigo is not well developed. An insect (the flea) often destroys the first crop of leaves ; next a louse destroys the plant later in the season : this, however, is not so bad as the first. The cutworm† also commits some depredations upon it.

Three vats or tanks, made of wood and water-tight, are employed in the manufacture of indigo. First, the steeper, which is sixteen feet square and twenty-six inches deep ; second, the beater, sixteen feet by twelve and four feet deep ; and third, the ‡lime-vat, which is ten feet square and three feet deep, into which is put two bushels of lime, and in the process of manufacturing one half-bushel is added to each subsequent vat made. No building is necessary except a light roof to protect the workmen.

Manufacturing Process.—Two methods are used, the cold and the hot. The cold is the safest ; the plant must be in a certain state to use the hot. 1st, by cold water.—The weed is put in the vat and covered with clear water, where it remains until the colour of the liquid becomes a light olive ; this is in about ten hours ; the weed must be pressed down by heavy scantling laid upon it. Draw the liquid off into the churn or beater. The churning must now be commenced and kept up until the fluid becomes lighter in its general shade and the blue fecula is seen in the water, which sooner begins from small quantities of lime-water being added from time to time during the process of beating. The quantity of lime-water that is used should be not more than one-tenth of the liquid that is in the vat. If the lime-water be all thrown in at once the lime more than saturates the carbonic acid, and the carbonate so formed will be precipitated, and thus injure the indigo. After the fecula shows itself distinctly in the water, the vat is allowed to be still for 4 or 5 hours, then the clear water is drawn off by faucets at different heights, leaving the indigo precipitated in the bottom.

2nd, the hot process.—The weed is put in the vat, boiling water is let on so as to saturate the plant and fully cover it. The weed is kept down by scantling thrown upon it. Allow the water to stand from five to fifteen minutes, according to the effect above mentioned. Draw it off through a faucet and sieve into the beater ; repeat until all the coloring matter is extracted ; beat or churn as above, omitting the lime-water ; remainder of the process the same.

The precipitated indigo still requires some further operations to bring it to a state of perfection (though it can be dried and sent to market as it now is). It contains particles that are imperfectly oxydated, consequently it has neither the colour nor properties of the best indigo. Continued beating would bring these to a proper state, but it would cause the particles first oxydated to imbibe an additional quantity of oxygen, by which the colour is too much

* Edwards, in his History of the West Indies, speaking of the liability of indigo to insect depredations, recommends as the sole remedy to change the soil every year. The want of attention to this important feature, he thinks, has probably been one of the causes why so many persons have failed in their attempts at cultivating indigo.

† Caterpillars have been known to clear off a crop in a single night.

‡ In India, the use of lime is avoided in the manufacture of superior qualities of indigo, as it has a tendency to make the indigo hard and red.

deepened, and the article would be rejected in commerce as burnt. To avoid this throw over the liquid fecula a volume of warm water double the quantity of the fecula, stirring it all the while; by this means the perfect indigo will be precipitated, the other held in suspension.

This water is drawn off and lime added, etc., as above, by which the green colour becomes a yellow brown and the indigo is rendered insoluble and precipitated.

That indigo may be pure and brilliant it should be twice washed, once in cold and once in hot water. After washing allow the fecula to settle, then draw off the water.

The last purification now is to mix the fecula with another quantity of water, in a vat having several faucets. While it is suspended the earths are precipitated; draw off while stirring, and allow to settle. The last operation consists in putting the fecula in a coarse bag of hemp or wool, and this bag in an open basket to drain, placing weights upon it until it becomes tightly compressed. These last operations are not requisite if a very common article is to be made; but it is well to follow all the purifications—the increase in price will cover the increase of trouble.

The further process of drying must be gradual in order that the substance may be free from cracks or roughness of surface. The wet indigo is put into boxes and dried with much care; the sun, exposure to which is made gradually and with caution, being the chief instrument. Some makers, however, dry wholly in the shade, believing that the superior results more than compensate for the great time occupied in the process. In the great indigo factories of Bengal, again, some part of the drying is effected by means of fire.

The following process of manufacturing indigo in small quantities for domestic use is given by the *Southern Agriculturist*:—Cut the indigo when the under leaves begin to dry, and while the dew is on them in the morning put them in a barrel and fill this with rain-water, and place weights on to keep it under water; when bubbles begin to form on the top, and the water begins to look of a reddish colour, it is soaked enough and must be taken out, taking care to wring and squeeze the leaves well, so as to obtain all the strength off the plant; it must then be churned (which may be done by means of a tolerably open basket with a handle to raise it up and down) until the liquor is quite in a foam. To ascertain whether it is done enough, take out a spoonful in a plate and put a small quantity of very strong lye to it. If it curdles, the indigo is churned enough, and you must proceed to break the liquor in the barrel in the same way, by putting in the lye (which must be as strong as possible) by small quantities, and continuing to churn until it is all sufficiently curdled: care must be taken not to put in too much lye, as that will spoil it. When it curdles freely with the lye it must be sprinkled well over the top with oil, which immediately causes the foam to subside, after which it must stand till the indigo settles to the bottom of the barrel. This may be discovered by the appearance of the water, which must be let off gradually by boring holes, first near the top and afterwards lower, as it continues to settle; when the water is all let off and nothing remains but the fecula, take that and put it in a bag (flannel is the best) and hang it up to drip, afterwards spreading it to dry on large dishes. Take care that none of the foam, which is the strength of the weed, escapes; but if it rises too high sprinkle oil on it.

By another process the leaves are first dried and the colour extracted by simple infusion, the colouring matter being fully obtained without either fermentation or scalding; the subsequent stages of agitation and precipitation being resorted to as in the case of the other processes. The prejudices of

the dyer again interfere to prevent the indigo so produced being largely used, despite the fact that scientific experiment has assigned to it a high value. Under this method the plants are cut in dry weather, and the leaves thrashed out. They are then coarsely broken up, and can be packed and stored for manufacture. In the course of four weeks the leaves undergo a material change, their beautiful green tint turning into a pale bluish-grey, previous to which the leaves afford no indigo by maceration in water. The colouring matter is obtained by macerating the leaves for about two hours, and then drawing off the green liquor, and treating subsequently as in the other processes. Some makers use hot water, but this is not essential. While the leaves are undergoing maceration they are kept constantly stirred.

At a former and not very distant period the culture of indigo was a profitable and material industry of the Southern States of the Union. For insufficient reasons, as it would seem, its culture has yielded to other products more attractive, if less profitable. At one time, previous to the revolution, it was as much a "king" as cotton became in the Southern States. When India was looked to for supplies, and at the commencement of the present century, the export of indigo from the United States had fallen off from a million to six thousand pounds. "It is not unlikely," says the Commissioner for Agriculture, "that among the causes of the abandonment of the culture were, first, the large amount of land required to be employed where the industry is conducted as a specialty; and, second, the risks and hazards in the way of successful manipulation after the fitting maturation of the plants. In the Indies the conditions of cheap land and labour are met, but still the crop is regarded as one of the most precious of the East, being liable to be destroyed by hailstorms. Plenty of land, labour at fair rates, and skill in handling enter prominently into the question of production for profit. It will be remembered, at the same time, that indigo is a nitrogenised product, and would therefore require the use of manures rich in ammonia to maintain the soil in a condition to yield a remunerative crop.

In the arts many processes in themselves good, and often favouring advantage of simplicity and economy, are rendered almost impossible by the prejudices of those who have to use the article manufactured. The quality may be equal and possibly superior, but a difference in form in which the article reaches the markets is sufficient to condemn it. A case in point is that of indigo made by scalding in place of fermenting the leaves. The objections taken by the dyers is that the article so made is spongy and light, that it contains less colouring matter than that obtained by fermentation, and that the dye is more evanescent. Dr. Roxburgh, however, gives a decided preference to scalding over fermenting, insisting that the *quality* is superior and the *quantity* increased by this process. For this method he recommends that copper vessels should be employed, ten or twelve feet long by five or six wide. The depth should not be more than two feet, lest the leaves near the bottom should be too much scalded before those at the top have all their colouring matter extracted. The after operations of agitating, &c., are pursued exactly in the same manner as under the fermenting process. "By the scalding process," he says, "I have always on a small scale made from the common indigo plant better indigo than I could by fermentation, and in one-fourth of the time, and, what is also of great importance, without the smallest degree of the pernicious effluvia which attends the manufacture by fermentation; and, moreover, the twigs and leaves themselves of the indigo plant burn fiercely after having been well dried, and will carry on the operation without requiring much addition of other fuel. The heat employed expels most of the fixed air during the scalding, which renders a very small degree of agitation, and very little of the precipitant (lime-water) necessary. The

operation can be performed two or three times a day upon a large scale; and, lastly, the indigo itself dries quickly without acquiring any bad smell or putrid unwholesome tendency."

I have already said that fermentation, although usually applied in the process of disengaging the colouring matter from the leaves, is not essential; and as the noxious smell arising from the rotten mass is attended with a prejudicial effect upon the operatives engaged in the manufacture, it becomes very desirable that this stage should fall into disuse. The system, moreover, requires much practical skill to determine the exact point for arresting the fermentation.

The agitation of the liquor by beating leads to fermentation, and by disengaging a great quantity of carbonic acid prevents putridity. It moreover affords to the newly-developed indigo its requisite quantity of oxygen by the most extensive exposure of its particles to the atmosphere, and it promotes the separation of the indigo, or, as it is technically called, the "grain."

"Indigo," says Dr. Royle, "is well calculated to prove that the success of the manufacture of a vegetable product, and therefore the extent of its commerce, depends as much upon skill, combined with energy, in the cultivators and manufacturers, as upon suitableness of climate to its culture." It seems, however, not improbable that the process of manufacture will be materially changed in cost and rapidity, and in the quality obtained. A chemist of some eminence in Ceylon, Mr. Schrottky, whose name is well known in connection with important researches into the coffee-leaf disease, has patented a process by which twenty-five per cent. of dry produce is obtained; while it is known that experimental research is being made into the subject by others.*

Experiments are also being made with some of the extracts of coal-tar, and it is probably only a question of time to produce artificially from a mineral basis a perfect substitute for indigo blue. In that case, as has happened with madder and cochineal, but on a smaller scale, the destinies of large districts in many countries will be altered, and the industry of thousands have to be diverted into new channels. The revolution which would be created by such a discovery will be better understood from the fact that in 1879—the latest statistics at hand—the indigo imported into England alone was worth £2,000,000.

Good indigo is known by the purity of its colour and its lightness, which latter quality is indicative of the absence of earthy impurities. When broken its fracture should be of a bright purple tint, of a compact texture, free from white specks or sand, and when rubbed with the finger-nail or other sharp substance, should have a copper-coloured shiny hue. It should float in water, and when burned in a candle should fly like dust. When heated to about 550° it evolves a reddish violet vapour, which condenses in minute crystals. The staple article comes to market in various qualities and under different appearances, which are most minutely classified.

Indigo is a highly dangerous vegetable poison. Its physiological effects are thus described by Pereira:—"Shortly after taking it the patient experiences a sense of constriction at the jaws, and the impression of a metallic taste on the tongue. These are followed by nausea, and frequently by actual vomiting. The intensity of these symptoms varies in different cases; in some the vomiting is so violent as to preclude the further use of the remedy. The matter vomited presents no peculiarity except its blue colour. When the vomiting has subsided diarrhœa usually occurs, the stools are more

* Artificial indigo is already procured from a basis bearing the alarming name of ortho-nitro-phenyl-propriolic acid; but neither in price nor quality does it yet successfully compete with the natural colouring matter.

frequent, liquid, and of a blue or blackish colour. The vomiting and diarrhœa are frequently accompanied by heartburn and colic. Occasionally these symptoms increase, and the use of the remedy is in consequence obliged to be omitted. Dyspepsia and giddiness sometimes follow. The urine has a dark-brown violet colour. After the use of indigo for a few weeks, twitchings of the muscles sometimes were observed, as after the use of strychnine. It has been employed chiefly in spasmodic affections, viz., epilepsy, convulsions of children, St. Vitus'-dance, and hysteria."

It is also applied in erysipelas, and the well-known application of the "blue-bag" in our nursery days, as a cure for reducing swellings caused by stings, had its origin in the curative properties of the indigo contained in the blue. The leaf of the plants has virtues of an alterative character, and is given in affections of the liver in the form of powder mixed with honey. Decoctions of the root are also given in cases of stone. Manufactured indigo in the form of powder is also used for cleansing ulcers.

Another by no means unimportant use of indigo is thus given by Lunan in his "Hortus Jamaicensis":—"The following is a negro secret, and superior to mercurial ointments for destroying the vermin which generally infest their woolly heads, and without the danger which attends the preparations of mercury for that purpose: Half fill a bottle with the clean indigo root, scraped like horseradish; on this so much strong rum as will cover the roots but not fill the bottle. Let the bottle be closely corked, frequently shaken, and exposed to the sun for some days. This infusion well rubbed in will as effectually and instantly destroy the vermin as if boiling water had been poured on the part. May not," says the author, "a strong decoction of the root boiled in water prove efficacious in killing fleas in dogs and cats, the lice in poultry, and animaculæ that occasion and communicate the mange among sheep, goats, and other animals?" If indigo root possesses all the virtues attributed to it, the Australian grazier might find in it a simple remedy for scab.

The indigoferas are by no means the only plants from which indigo is produced. The "wild indigo" or "horsefly-weed" (*Baptisia tinctoria*), a legunous plant indigenous to North America, is much used in the United States for the manufacture of indigo for market. It grows from the seed (which is heavier than that of other varieties), and once planted annually come up in the spring from the roots, its vigour increasing until, on account of the annual cuttings and removal of all vegetation, the ground is entirely exhausted. This happens in from six to ten years. No fence is needed to enclose it, as stock will not interfere with or eat it. Those who have planted it here never use manure of any kind, nor ever plough it. The hoe alone is used to keep down weeds and grass after each cutting. Very soon the plant from the strong roots puts out vigorous sprouts, which shade the ground and keep down other growth. Hence its cultivation is very easy and the cost small. The greatest labour is in cutting, which is done with the common reap-hook and is a very slow process. This part of the work must be done before the dew dries off the plant, and the plant is transferred to the vat before it wilts. For this reason more hands are required than otherwise would be necessary. If a light reaper that could be pushed by hand were manufactured the expense would be greatly lessened. Manual labour is necessary because the plants are put in new land, and there are always too many stumps to allow the work of horses. With the use of a mower and the application of fertilisers the business might be made one of great profit. As it is, indigo pays better than cotton, although cotton cultivation has almost quite superseded it. One cause of this supersession is that indigo cultivation is considered an unhealthy busi

ness. The land best adapted to indigo is a sandy soil, the poorer parts of a tract; hence when it ceases to yield this plant it is fit for nothing else. The indigo is cut as long as it will sprout, and coming up from the root it sprouts as long as there is any nutriment in the ground.

The physiological effects and medical uses of this plant are very similar to those of the true indigo. The fresh plant attached to the harness of horses keeps off flies and is much used in Virginia for that purpose.

The old fashioned "woad," the product of *Isatis tinctoria*, the manufacture of which was so much interfered with by the East Indian indigo, is still made in considerable quantities in France and Germany, being a favourite with the dyers on account of its cheapness and the durability of its colour. This plant and the *Baptisia* would suit the high lands of this colony.

In Northern China, also, a species of *Isatis indigotica* is very largely grown; the produce of indigo in the South being insufficient to provide the enormous quantities of blue dye required for the standard colour of the clothing of the teeming masses of China. There the plant is also used as a vegetable, being considered wholesome and nourishing. Several other plants are grown in China for blue dyes.

I cannot readily discover if indigo or any of its allies or substitutes are cultivated in Japan; but it is stated in the "Journal of Applied Science" that the water in which rags have been boiled at the Osaka Paper Mill is utilised for the purpose of recovering the indigo thus found in the waste. Most of the stock used at the mill consists of blue rags. After the waste has been drawn off, the indigo in suspension is extracted and made into cake indigo of very fair quality, said to be good enough for dyeing cheap fabrics.

In Paraguay the preparing of indigo from an herbaceous plant, a species of *Eupatorium*, is said to constitute a large industry. Indigo occurs also in two of the most common terrestrial orchids of Queensland—namely, *Calanthe veratrifolia* and *Bletia Tankervilleæ*. These are both large bold-growing plants with conspicuous flowers, and the latter especially is found in large quantities in the swamps of Moreton and Stradbroke Islands, and indeed under similar conditions all along our coast lands.

To Dr. Roxburgh is due the discovery that indigo is largely present in *Nerium tinctorium*, a middling-sized tree, allied to the common oleanders. The colour of the leaves acquired in drying for his herbarium, particularly if they chanced to be bruised, first induced him to think they possessed colouring matter; and the result of some experiments fully answered his expectations, although he afterwards found that the natives of certain parts of India had been in the habit of making indigo from the leaves of this tree long prior to his discovery. The trunk of a full-grown tree is from one and a-half to two feet in diameter and from eleven to fifteen feet high before the branches begin. The leaves are numerous, growing in pairs opposite to each other on short stalks. At their greatest growth they are from six to ten inches long and from three to four broad; they are nearly oval but terminate in a point. The flowers are handsome and of a blue colour. The tree grows abundantly throughout the Carnatic, over an extent of country of above one thousand miles in length. The wood is white and close-grained, and is extremely good for fuel. The best way of pruning the tree so as to obtain the greatest supply of leaves is exactly that used in the case of the mulberry for a similar object. The tree is kept low, and, like the mulberry, the more it is cut down the more vigorously it grows. It sheds its leaves at the commencement of the cold weather; but at the earliest Spring it begins to put forth its new foliage and to expand its blossoms.

When the first leaves have arrived at their full size is considered the most favourable time for commencing to gather them, for the purpose of extracting the colouring matter. The gathering of the leaves may be continued during the four next succeeding months. Towards midsummer they are most rich in colouring matter, but as the fall approaches they acquire a rusty colour and are no longer in a fit state for yielding indigo. The leaves of very young trees do not yield any colouring matter; those raised from seed do not furnish any till they are more than two years old, and then only in small quantity. They likewise differ in one particular essentially from the common indigo plant—they do not yield their colour to cold water. Dr. Roxburgh tried every means towards this end, but without satisfactory result; but by means of hot water the colour is readily extracted. These leaves yield the best indigo after being kept a day or two; but, differing essentially in this respect also from the common indigo plant, when quite dry they become valueless.

The process for extracting the colour, as described by Dr. Roxburgh, is exactly similar to that which, according to his recommendation, should be used in making the ordinary indigo. The leaves, collected on the preceding day, are put into a copper vessel so as nearly to fill it without being pressed down. Water is then poured over them until it reaches to within two or three inches from the top of the boiler. The use of hard spring water extracts more colour than rain or river water. The fire is then lighted, and heat is applied till the liquor assumes a deep-green colour when viewed in the vessel. The leaves will then appear of a yellowish colour. The temperature of the whole will at this time be from 150° to 160° Fahr. The scalding takes about three hours, during which time the leaves should be constantly stirred about, and turned upside down, that they may be all equally exposed to the action of the fire. The agitation thus produced has likewise another good effect in expelling the carbonic acid gas, by the separation of which the process is much forwarded. As soon as the leaves and liquid assume the appearances above described, the fire is immediately damped, and if there be more than one boiler, the contents of which are to be poured off into one agitating vat, each should be in a state of equal forwardness so that the whole quantity may be at once collected. In making this transfer the liquor should pass through a strainer to keep back every part of the leaves. It is then agitated in the ordinary way while hot for a few minutes, and this will generally produce sufficient granulation. Before the liquor is cool about $\frac{1}{75}$th part of pure lime-water is added; this being intimately mixed, a very large grain is speedily produced which soon precipitates. After subsidence the supernatant liquor is drawn off, and the indigo is subsequently treated exactly as in the making of common fermented indigo. If the process has been properly conducted, the liquor will be of a clear amber colour, which is a proof that it retains none of the blue colouring matter. To produce one pound of indigo, between two and three hundred pounds of green leaves are necessary; but the quantity will vary according to the season and the state of the weather in which they are gathered. As soon as the liquor is poured into the agitating vat it is emptied of its leaves and refilled with a fresh supply of these and water, and the process thus continues with rapidity.

I have dwelt at some length upon this plant, because I think it affords the prospect of a profitable industry to the Queensland agriculturist. The tree has not been introduced into the colony yet, but it seeds freely, and I have no doubt that the Acclimatisation Society, if moved in the matter, would readily obtain seeds or plants. This species of indigo plant does not appear to be subject to any disease, nor is it liable to the devastations of insects, nor to any of the numerous vicissitudes which, as already described,

beset the cultivation of the *Indigoferas*. While the common indigo requires constant and expensive culture on a good soil, and is even then subject to many accidents against which no human foresight can guard, and at best requires renewing annually, the *Nerium tinctorium*, once planted, requires no more attention than a mulberry plantation, and less than a vineyard.

JACA, or JACK-FRUIT.

(*Artocarpus integrifolia*.—ARTOCARPACEÆ.)

This tree is a native of India, but has been so long cultivated in other hot countries as to be found casually wild in many places. It is much hardier than its congener, the bread-fruit; making a large tree, and maturing its fruit at a lower latitude and in drier climates.

The jaca requires a deep and well-drained soil, and where these conditions are fulfilled it grows to a tall, handsome, and umbrageous tree. Under favouring conditions its growth is rapid; and it rises in a beautiful pyramidal form, branches almost to the ground, with a very dense foliage, to a considerable size. Where, however, the ground is stony and shallow, and the root-run restricted, the growth is stunted and it makes by no means so fine a tree. Favourable conditions in this respect are wanting at Bowen Park, where the Jaca has not been successfully grown. It is stated by Indian authorities that in cases where the roots find their way to water, the tree, although it thrives in other respects, does not bear fruit.

The fruit grows to an enormous size, and is produced on young trees on the branches, on more mature specimens on the trunk itself, and in very old trees on the roots. In the latter case the presence of the fruit is indicated by the cracking of the superincumbent soil, and the fruits so produced are held in the highest estimation.

There are several varieties, more than one having been introduced into Queensland; but that known in India as the "honey jack" is the favourite there, and the "champâdak" in the Malay Archipelago.

Opinions differ greatly as to the value of the fruit. Containing a large amount of saccharine and glutinous matter, there is no question that it is both wholesome and nutritious; but when at its best stage for eating it emits an overpowering scent, which to some people is not only disagreeable but absolutely nauseating. The presence of a ripe jackfruit in a large house is perceptible from cellar to garret; and when preparing it for eating it is always desirable that the succulent pulp enveloping the seeds, which constitutes the edible portion of the fruit, should be extracted out of doors, so as to present at table as small a perfume-emitting surface as possible. There is no doubt, however, that those who once take to the fruit become exceedingly fond of it; the French proverb, *ce n'est que le premier pas qui coute*, being remarkably applicable to the case. The writer has known persons turn pale and retire precipitately at the very smell, and others to eat with avidity the identical fruit which had produced this result.

This disagreeable smell can be removed by washing in salt and water, the traces of salt being in turn removed by fresh water.

There is a way, however, of treating the jackfruit so as to produce an excellent dish, perfectly void of offence. The following receipt having been tested in Brisbane is known to accomplish what it professes:—

"If the edible pulp of the fruit be taken out and boiled in some fresh milk, and then be strained off, the milk will, on becoming cold, form a thick jelly-like substance of the consistency of blanc-mange, of a fine orange colour and of a melon-like flavour. Treated in this way the fruit affords a very agreeable dish for the table."

The seeds, roasted or boiled, are equal to the best chesnuts ; and as a large fruit will contain from one to two hundred seeds, this alone gives a value to the fruit even to those who cannot bring themselves to eat the pulp.

The milky tenacious juice more or less common to the whole family is abundantly produced from the bark of this species, and is used as birdlime and for other purposes.

The timber is largely used for all kinds of furniture, for building and carpentering. The best wood is close-grained and mottled, and takes a fine polish. Much of it is sent to England, where it is used for marqueterie, turning, and for brush backs. The root wood of old trees is dark-coloured, and is in great request for carved work of all kinds. A yellow dye is obtained abundantly from the timber, being extracted principally by boiling the sawdust.

The jaca is propagated from seed, which should be sown fresh from the fruit, as it soon loses its vitality. In Travancore the natives put the entire fruit into the ground, and when the seeds germinate and grow up they tie the stems together, which by degrees form one stem, a method supposed to induce earlier fruiting.

The following curious method of training the tree by the natives of India is quoted from a high authority :—

" Sow the seed imbedded in its own pulp. Fix over the young shoot, immediately upon its appearing above ground, a narrow hollow pipe, made by the union of the two halves of a bamboo, that has been split in two in order to remove the inclosures at the knots, and tied together again with string. This bamboo pipe must be about three or four feet high. The jack will soon ascend the pipe, and make its appearance at the summit. When it does so, remove the halves of the bamboo. Lay the young shoot, which will be found perfectly supple and pliant, upon the ground and twist it into the form of a spiral cord, with the crown of the root for its centre. Cover this coil well over with earth, leaving the end of the shoot to project from the ground. The plant thus treated will grow in about five years time into a tree, the spiral portion of it below ground enlarging correspondingly at the same time. Upon this spiral the fruit will uniformly be produced, and of the finest quality and largest size."

The jaca is largely used as a shade tree in coffee plantations at low elevations, and under certain conditions of aspect and soil, where shade can be applied without injury.

For purposes of ornament or of shade simply it is an admirable tree, wherever climate and soil permit its successful growth.

JAVA ALMOND.

(*Canarium commune.*—AMYRIDACEÆ.)

This tree is a native of Malaya and the Indian Archipelago, and is cultivated in India and other warm countries. It is a fine-looking tree with beautiful oval oblong leaves, and attains under favourable conditions a height of fifty feet. It is cultivated for its nuts, which in flavour are like an almond, and are eaten both raw and dressed ; but they should be eaten in moderation, as if indulged in too freely they are apt to bring on diarrhœa. A kind of bread is made from them, which, in Amboyna, takes the form of rolls about a yard long and an inch thick ; and they are also preserved in sugar, making a sort of marmalade. The nuts are three-angled and very hard ; and although

the tree bears well at Bowen and on the coast more to the north, owing to a certain amount of difficulty in extracting the kernels they are not much in favour. In medicine they are used as an emulsion, taking the place of European almonds, which are often spoilt by long keeping. An oil is expressed from the kernels, which when fresh is used at table and in cookery. It does not keep, however, and acquires a pungent smell, congealing into a buttery camphoraceous substance. A resinous yellowish-white exudation comes from the bark, which is reputed to possess the same properties as balsam of copaiva, and in the form of ointment is used as an application to indolent ulcers.

The Java almond is a handsome umbrageous tree with white flowers. It is propagated freely from the nuts; but it does not bear the winter so far south as Brisbane.

LIBERIAN COFFEE.

(*Coffee Liberica.*—RUBIACEÆ.)

This species of coffee takes its name from Liberia, a region of Western Africa, so called from its having been selected for the settlement of a band of liberated slaves from the United States of America about sixty years ago. The tree is indigenous to the forests of Liberia, at or near the sea-level; but, although a true coffee, bears little or no resemblance to the *Coffea Arabica* or any of its varieties. The plant, which is in fact a small tree, is in all respects larger. Its grand dark-coloured leaves are more like those of the jack tree, attaining under favourable conditions dimensions as large as 2 feet by 1 foot, while the berries, compared with those of the common coffee, attain an enormous size. Cherries are mentioned which measured 2 inches by 1 inch, the beans inside being 1⅛ inch long.

But besides these points of distinction, Liberian coffee differs materially in other important features from its ally. It is more prolific, favours low rather than high elevations, and the ripe berries do not fall from the tree. This latter habit is regarded as valuable, as it permits the harvesting of the crop to be done more at leisure where labour is not abundant. Experience also shews that, while not enjoying absolute immunity from leaf disease, its more robust habit enables it better to resist the attacks of this scourge.

The spread of Liberian coffee, from its native habitat to other countries suited to its cultivation, has been mainly accomplished, like that of hundreds of other valuable economic plants, through the instrumentality of that great centre of scientific and industrial botany, the Royal Gardens of Kew. This plant was first grown there in 1872; thence two years later it was sent to several of the British West India possessions, and either directly or indirectly through the same source found its way to Ceylon, Brazil, Calcutta, etc., and to Queensland. To Mr. William Bull, the eminent nurseryman of Chelsea, the tropical world is also largely indebted for the spread of this important additional to economic botany. Of the trees in Queensland, some were grown from seed sent from Kew to the Acclimatization Society. Several consignments failed owing to the perishable character of the berries, but success at last was attained by the method of sending small quantities, packed in damp moss in tin boxes, through the post. Another lot of plants were brought to the colony by Mr. H. A. Wickham, of Maragen, Herbert River, in a wardian case packed at Kew. Of these plants, Mr. Wickham, in a letter recently addressed to the writer, speaks thus:—"The Liberian coffee

trees I have still continue to look very promising. The original plants which I brought out with me from Kew have had a fair show of berries for some time past. I believe the tree will have to be treated more as a fruit tree than an ordinary coffee shrub. It is certainly very vigorous in its growth, and I find it does best here in the alluvial. Though much hardier it is much more sensitive to fall of temperature—evidently essentially tropical. It would, I believe, do yet better further north than this, away from the cold July nights. I have been so occupied with my tobacco manufacturing that I have not given this beautiful tree a fair chance with me. I have great faith in it, so much so that had I foreknown the difficulty of and prejudice to be contended against in introducing locally-grown tobacco in this colony, I should have followed my original intention of planting this in conjunction with the other coffee. In the case of anyone laying out land for coffee—not south of this district—I would recommend that the low-lying land of the proposed plantation, always with the understanding that there be no clay beneath, should be marked off for the Liberian."

Having briefly introduced the tree, I will now proceed to deal separately with the more material points involved in its cultivation.

In Liberia this coffee flourishes from sea-level up to an elevation of 500 feet, beyond which it does not appear to have been tried. In India and Ceylon it succeeds well at various elevations, according to natural advantages, in the latter country bearing well in a genial climate at an elevation as high as 3,000 feet. It enjoys moisture in combination with heat, being, especially in a young state, impatient of dry weather if at all prolonged. In proportion as the climate is dry, resort must be had to shading and mulching of the plants. "The great merit of Liberian coffee," says Mr. Ferguson, speaking of Ceylon, "is that, with its deep, strong taproot, its thick rough tree-like stem, its large foliage, and its robust habit, altogether it is eminently qualified, once it is established, to withstand those prolonged droughts to which the low-country region is liable." The early stages of the plant are clearly the most difficult, and in Queensland, as in India and Ceylon, experiment only can decide the best regions for the cultivation of Liberian coffee. Here as elsewhere local conditions of elevation, rainfall, and quality and level of soil will largely govern success, and the best combinations in each locality will have to be determined by actual test.

The climate of Liberia is very similar to that of the Northern coast of Queensland in the respect that both have heavy rainfalls succeeded by protracted dry weather, which the strong taproot of the tree enables it to withstand without diminution of crop.

In the matter of soil, the points upon which the plant insists are that it shall be loose and deep, clays or clay subsoils being wholly unsuited to its demands. These essential conditions being present, the richer the soil the better, so as to save the necessity of manuring before the trees bear and will themselves pay for this always costly item in cultivation. Partially exhausted soils should be avoided in any case, if experimental cultivation is to have fair play.

The chief and best method of raising plants is from seed. There are a sufficient number of bearing trees now in Queensland to meet a reasonable demand for seed, but, if necessary, ample supplies can be drawn from Ceylon. Some three or four years ago, four boxes of Liberian coffee seeds were consigned to the writer by a mercantile firm in Ceylon; three of these were placed in the hands of planters, whose reports were made direct to the firm referred to, but the contents of the fourth box were grown in the garden of the Acclimatisation Society, under the writer's personal superintendence.

As more than fifty per cent. of these seeds germinated, and as since then the Society has received seeds from Dr. Trimen which germinated still more freely, there would be no risk in drawing supplies of seed from Ceylon if the commission to pack and despatch were entrusted to experienced hands.

The method of raising Liberian coffee seeds is similar to that already described for ordinary coffee. They are a little, but not much, longer in germinating, and the necessity for shading the young plants is imperative. The shade should not, however, be dense; a broken sunshine, effected by brushwood or open basketwork, being the best treatment. The soil, when in open beds or in boxes, must be deep and well drained, so that the tender taproot of the young plants may not be obstructed. Sow in the spring, and under proper treatment the young plants will be ready for transplanting in from five to six months from sowing.

Cuttings strike readily, but this method of raising plants is not resorted to if seed is obtainable. Nor is it certain that the deficiency in taproot following this means of propagation does not affect the fruitfulness of the tree and its capacity for withstanding drought.

The distance apart at which the trees are planted varies, according to opinion and circumstances, from 6 feet to 12 feet. Even at the greater of these distances these trees will eventually meet if they are topped and pruned. Opinions vary as to the relative advantages of leaving the trees to grow to their natural size with only such symmetrical pruning as is given to other cultivated fruit trees, or topping and pruning as in the case of ordinary coffee shrubs. A plantation of well-kept but untopped trees is a grand sight; and as they bear richly, the question resolves itself mainly into one of economy of labour in obtaining the crop. There is also a certain amount of risk of injury to the trees from ladders used by careless workmen.

The Liberian coffee is very prolific, but of course its yield is subject to the various influences which govern the produce of other fruit-bearing trees. Compared with *Coffea Arabica* it is a very heavy producer. A Ceylon planter of experience, from personal observation in Liberia, says that an estate of twenty to thirty acres well looked after would yield as much coffee as one with 200 or 300 acres of *Coffea Arabica*. In "The Colonies and India" it is stated that, in an official report on the interior of Liberia, Captain Vaulan, of the U.S. Navy, says "some plantations have as many as 200,000 trees producing from 1 up to 12 lbs. per tree, worth 18 cents a pound. The tree produces in its third year, and thence on to thirty years. Estimating 450 trees to the acre and a yield of 4lbs. per tree, we have at the end of the seventh year 324 dollars (£67 10s.) per acre annually. The labour for this production is small, and with simple machinery invented and made in America the berry is extracted from the hull." At a low elevation a tree in Ceylon yielded at one picking 2,600 ripe cherries, leaving 2,900 ripening up—not an exceptional instance. The season was, however, unusually moist and favourable.

In Dominica the introduction of Liberian coffee is fast reviving the coffee industry, which was so injured by a blight attacking the plantations that the cultivation of coffee became almost extinct. The productiveness of the trees there is a matter of astonishment to the older residents who remember the coffee plantations in their vigour forty years ago. The flavour of this coffee is regarded as quite equal to Java, the young trees are unaffected by blight, and their fruitfulness surpasses all expectation. The source from which this statement is taken also says that Liberian coffee from Ceylon has obtained 93 per cent. in the New York market—that is 12s. above the quotation at the time for middling plantation Arabian.

In 1876 Dr. Thwaites, who was then Director of the Royal Botanic Gardens of Ceylon, drew up a memorandum comprising a series of questions upon the habits and requirements of the Liberian coffee. This document was sent, through the official channels of the Governor and the Colonial Office, to Sir Joseph Hooker, who, through the medium of a mercantile firm of Liverpool having commercial relations with Liberia, obtained answers, from a reliable local source, to Dr. Thwaites' enquiries. I do not think I can do better than summarise the foregoing short account by giving these answers, which are categorical and exact replies to the questions propounded:—

"1. The Liberian coffee grows equally well in the immediate neighbourhood of the sea and at considerable distances from it. Under like conditions of soil and cultivation, trees near the seashore in Monrovia are about the same as those at Careysburg and other places thirty miles distant. The wild coffee, from which the cultivated comes, is found at even still greater distance in the interior. Our nearest trees are a hundred yards from the sea. At Bassa and Sinon, we are told, trees grow well still nearer to the sea.

"2. Lowest temperature observed at Monrovia, near the sea, 62° Fahr. at 7 o'clock a.m. in the month of January, during the prevalence of the harmattan winds. Highest temperature observed, 91° Fahr. These are exceptional cases. The general temperature ranges from 72° to 87° in the shade. In the country at the furthest point where coffee is cultivated by the settlers, there is a difference of one or two degrees lower, owing principally to the rise of the land. Along the coast the coffee-tree thrives at only a few feet (say 10) above the sea-level; at Careysburg and at Mount Coffee it succeeds as well at an elevation of 550 feet.

"3. The coffee-tree grows as well on level ground as on slopes, with this precaution,—care should be taken that on slopes the rich mould or surface soil be not washed away, and on level ground that the water does not stand; for, while the leaves of the coffee-tree delight in frequent refreshing showers, the roots are averse to *standing* water.

"4. Virgin forest soil is considered best for the coffee-tree, simply because it contains sufficient plant food, and saves the expense of manuring for several years. Ordinary soil will answer as well, provided it contains sufficient plant food, or otherwise can get a sufficiency of manure.

The soil should be of loose texture; the tree will not thrive in stiff clay soils.

"5. There is a distinct variety, coming sooner into bearing (18 months), and giving a smaller berry. But the larger variety is preferred, as yielding a superior coffee and a larger crop. But the larger berry varies somewhat under changed conditions of soil. The same berry that is very large in moist lowlands becomes a little smaller, but of finer flavour, in the dry rocky hills or uplands.

"6. The trees on a plantation differ in the size of their berries. Besides, while many contain berries of a uniform size, others will contain berries of various sizes. We are not prepared to say to what extent *high cultivation* would remedy this. In planting nurseries with the seed of a uniform size, we have not been able to obtain plants of a uniform size.

"7. The coffee-tree does not produce well under shade, either in the quantity or quality of the crop. When the trees are not large enough to shade the ground with their branches and fallen leaves, they should be *mulched* in the dry season—*i.e.*, their roots should be covered with dry grass, straw, shavings, or anything capable of shading them, but the leaves and branches should have the influence of the sun to elaborate a due proportion of sap into

fruit buds. The Liberian coffee being indigenous, when well established, does not suffer from our tropical sun. *Mulching* in the dry season is generally required for very young trees on dry hilly slopes.

"8. Both methods of planting are adopted. Some trees are planted close (6 to 8 feet), while others are planted at greater distances (10 to 12 feet). When trees are planted close so that they meet, they thrive and bear well, provided their leaves and branches have the influence of the sun. There is also this advantage—by shading the ground they prevent the grass from growing, and thus save the expense of weeding. But it is very inconvenient to pass among them for the purpose of gathering the crop, pruning, manuring, etc. Even at the distance of 12 feet, if the trees are topped and kept down, they will eventually meet.

"9. The smaller variety referred to above begins to bear at 18 months, but the ordinary time for the larger variety is in the third year. Some plants of this kind, however, have been known to bear sooner. The first crop is generally only a few berries, but the tree goes on increasing until it becomes capable of yielding 20 pounds. We have heard of trees giving 24 pounds each; those are very old trees. More, generally, depends upon cultivation than upon age.

"10. The tree grows to a height of twenty feet or more—we have seen one more than thirty feet in height; this was in the woods near an old plantation. Some cultivators top their trees, others let them grow up *ad libitum*. Our trees are topped at a height of five feet. Trees that are topped are more conveniently picked, and, other things being equal, give a larger crop; when the trees grow up tall, moreover, they are frequently injured by climbing with ladders, and pulling down the limbs, &c.; and, as the tree ripens its crop and blossoms for the next year at the same time, much of the blossom and young fruit is rubbed off the trees; whereas the low trees are picked by standing on the ground.

"11. Manuring is not done extensively, owing principally to the fact that most of the plantations are young, although there are some that need manure. We use the coffee pulp mixed with cattle manure, also decomposed vegetable matter, wood ashes, "the compost heap," the earth from the hills made by the white ants (termites), &c. The coffee-tree delights in nitrogenous manures. We find surface manuring best for the coffee-tree here, as the fibrous roots or feeders keep always near the surface.

"12. We have no *very* old plantations; but we believe the plantations can be kept up permanently, or at least for a great number of years. With us the coffee plant is not a shrub; it is a forest tree. There are trees here 40 years old, flourishing in all the vigour and verdure of youth, and bending down under their weight of berries. We have seen a few of these old trees, when cut down, shoot up more rapidly and more vigorously than when first planted from the seed.

"13. Last year some of the trees on different plantations were affected with what was said to be the disease *Hemileia vastatrix*. The leaves of the trees turned *yellow* (although want of cultivation will cause the same phenomenon); there was a tendency in some of the upper branches to decay and dry up the berries before they could ripen. This may have happened before, but we observed it only last year. Occasionally the bark of a tree will decay, partially or wholly; when wholly, it causes the death of the tree. Occasionally a borer will attack a tree. We have as yet observed nothing that would cause serious losses in coffee-growing in Liberia. We rather think that the yellow appearance in some of the trees was owing to cultivation. Some of the trees supposed to be diseased were as full of berries as the other trees."

LIQUORICE.

(*Glycyrrhiza glabra.*—LEGUMINOSÆ.)

This plant is a native of the south of Europe; also of Syria, Persia, and China. It is cultivated largely in Spain, whence the names of its products—"Spanish juice" and Spanish liquorice"; also in Italy, the produce from which comes to market under the designation of "Italian juice." It also forms an important crop in some parts of England, notably in the neighbourhood of Mitcham and Kew in Surrey, and near Pontefract in Yorkshire. The liquorice from this latter place comes to the market in a refined form—in small flat cakes or lozenges—known as "Pontefract," or, as it is pronounced, "Pomfret" cakes.

Liquorice is a perennial herbaceous plant, having very much the appearance of a vetch. It has an erect stem, attaining the height of 2 to 3 three feet, with pale lilac flowers producing a peach-shaped fruit containing seeds like a minute vetch. The plant is grown for its long cylindrical tap-roots, about the thickness of a finger, which strike to a great depth in the soil, sometimes attaining a length of 5 or 6 feet. The roots are brown outside and yellow within; are flexible, tough, and succulent, abounding in a mucilaginous sweet juice, slightly bitter, which is readily soluble in water. The odour of the root is rather sickly and earthy.

Cultivation.—The nature of the root indicates that it requires a deep light soil. Unless the soil is naturally deep, or made so by subsoiling, and enriched with manure if not naturally in good heart, the plants will, in dry hot weather, become diseased or weakened and preyed upon by insects, being particularly liable to the attacks of the insect known to all gardeners as the "red spider." Planting is done in the spring with cuttings, 6 inches long, from the small horizontal roots of established plants. The cuttings are placed 18 inches apart, in rows not less than 3 feet apart, so as to admit of working the soil between the plants; frequent loosening of the soil between the plants being regarded as of great importance. The cuttings are entirely covered with soil, and the first year a light crop of lettuce or onions may be cultivated between the rows. During the summer the ground must be kept free from weeds. As winter approaches the stems will become yellow and wither, when they may be removed and the ground be hoed and dressed. If young plants are required for a new plantation they can be procured at this time by forking up the spreading roots near the surface and preserving them in sand for spring planting. These will keep well if stored in a cool dry cellar; and if wanted to travel by water the more matured roots, packed in the same manner, will keep for three or four months.

In three years the main roots will be mature and fit for use. In the course of the following winter they are dug up. A trench is opened close to the first row, as deep as the roots go. The roots are then turned out with a spade clean to the bottom, and the work is thus carried on from trench to trench. It is important to clear the ground of all the roots, small as well as large, as any left in the ground will grow again on return of warm weather, and interfere with whatever other crop follows.

The marketable portions are trimmed of all side roots, washed, dried, and tied up in bundles; if kept for any length of time they should be covered with sand until wanted for use. If kept warm and allowed to become damp, they are apt to get mouldy.

To raise plants from seed, a properly enriched and pulverised spot of ground should be selected, and the seed sown thinly in shallow drills early in spring. In rich soil and under favourable conditions the growing plants will be strong enough for removal after one year's growth; but a second year's growth in the nursery rows will afford better root cuttings.

Manufacture.—Liquorice is one of those products which require no appliances except of such simple character as are within reach of the most humble cultivator. It comes to market in various forms, viz. :—(1.) The raw product, being the roots simply dried and tied in bundles. (2.) "Spanish juice" in short thick rolls, five to six inches long and one inch thick, which are wrapped in bay leaves; and in the form of an extract run into boxes of about two cwt. each, which is the purest form. (3.) Pipe liquorice, which, theoretically at least, is a more refined description, in long thin pieces of the shape and about the size of the stem of an ordinary clay tobacco-pipe. (4.) Pontefract lozenges before described. (5.) Liquorice powder, which is made by drying and pulverising the root. When this is carefully done, the powder should be of a brown colour and of a pleasanter taste than the fresh root. It is soluble both in water and alcohol.

For making the extract the roots are first thoroughly cleaned, and, after being half dried by exposure to the air, are sliced up into small pieces and boiled in water until the liquid is thoroughly saturated with the sweet mucilaginous juice. If boiled too long the sweetness is impaired. The decoction is allowed to rest in order to permit the dregs to subside; and the clear liquor, after straining, is evaporated until it reaches the proper consistence.

The resultant extract is then run into boxes or made into rolls which are dried in the air, and while yet sticky are wrapped in bay leaves.

The foreign extract is frequently made from those roots which are unsaleable, and, apart from actual adulteration, it contains impurities such as sand, etc.

Alcohol merely extracts the saccharine matter without the mucilage. The spirituous extract is therefore sweeter than the watery, and is afforded in less proportion.

Refined liquorice is made by simply redissolving the impure extract, straining out any foreign matter, and again evaporating.

The active principle of the root, "glycyrrhizin" or "liquorice sugar," belongs to the uncrystallisable sugars which are not susceptible of vinous fermentation. It is yellow and transparent and has the sweet taste of the root.

The physiological effects of liquorice are emollient, demulcent, and nutritive. In medicine it is used as a demulcent in catarrhal affections and irritation of the mucous membrane of the bowels and urinary passages, and is a common remedy in hectic or phthisical cases. It is best given as a decoction by boiling an ounce of bruised root in a pint of water. For medicinal purposes the outside skin should be scraped off, as it possesses a slight degree of acridity. The powder is used in the preparation of pills either to give them proper consistence or to prevent their adhesion.

One of the most important uses to which the extract of liquorice is put is in the brewing of porter, as an ingredient of which it is extensively employed in England.

The root is largely used in Chinese pharmacy, being the grand corrective adjunct and harmonising ingredient in a host of recipes. Like most celebrated Chinese drugs it is charged with the property of rejuvenating those who consume it sufficiently long. It is used to allay thirst, feverishness, cough, and distress of breathing. Tonic, alterative, poison-neutralising, and expectorant qualities are ascribed to what is at best little more than a vehicle or disguise for drugs of real efficiency. Liquorice is not made into an extract in China. It is used with honey as an application to children's burns and to whitlows.

Adulterations.—While liquorice is used as an adulterant of tobacco and opium, it is itself largely the subject of adulteration in all its forms—in fact, as met with in commerce it is rarely pure. When pure and genuine, extract of liquorice is *entirely* soluble in water. Roll, case, and pipe liquorice, and Pontefract lozenges are all the subjects of adulteration with such admixtures as gelatine—often no better than mere glue, wheat, rye, barley, rice, and potato flour, chalk, starch, and cane sugar. So clumsily is sometimes the admixture that the flour and chalk may be picked out with a knife. It frequently shows traces of copper from the boilers used in the process of extraction.

"Spanish liquorice"—says Accum—"is frequently nothing else than a mixture of the worst kind of gum-arabic imported for such inferior use as that of assisting in the manufacture of shoe-blacking, A solution of the genuine liquorice is mixed with a solution of the gum; and the mixture, after being evaporated to a proper consistence, is again made up into cylindrical rolls which, while still moist, are covered with bay leaves, and repacked in chests, to resemble in every respect the genuine Spanish liquorice imported from Catalonia. It is difficult to detect this fraud. Genuine Spanish liquorice should be perfectly black, brittle when cold, and break with a smooth and glassy fracture; it should not become sensibly clammy or damp when exposed in a dry place; it should be sweet without any flavour of burned vegetable matter; and be soluble in water without leaving any residue.

In the powder are found wheat flour, woody fibre, turmeric, Indian corn, potato and sago flour, arrowroot, cane-sugar, and chalk, some of the adulterants being themselves highly impure.

Liquorice is also made from another species of *Glycyrrhiza*—*G. echinata*—but the properties of the roots of this species, while in all respects similar, are possessed in less degree than in *G. glabra.*

What is known as "Indian" or "Wild" liquorice is a product of the root of *Abrus precatorius*, a climbing plant indigenous to the East and West Indies, Northern Queensland, and the Eastern Archipelago. The pretty bright scarlet seeds of this plant, with the jet-black spot at one end, will be known to many of my readers. This plant is grown in the South of China, but, strangely enough, not for its root, which contains its main, if not only, virtues. The Chinese attribute to the seeds, which there as in India are also used as beads, various medicinal properties. The American name given to this comparatively worthless drug, as used in the form of seeds, is "crabs-eyes."

The amount of extract annually imported into England is about 600 tons; but I have not been able to find the annual quantity of the root grown in England, or the amount of product obtained therefrom.

KEI-APPLE.

(*Aberia Caffra.*—BIXACEÆ.)

A large shrub, a native, as its name indicates, of Kaffirland, although found elsewhere in Southern and Eastern Africa. It is densely clothed with thorns, and this, together with a dropping habit of the branches, adapts it admirably for hedges, which are impenetrable. It is a handsome shrub, with rich dark foliage, which contrasts strikingly with the plum-shaped fruit of a golden-yellow colour. The fruit has no value in its raw state for the table, although it is quite eatable, but it makes an excellent jelly, and when unripe is largely used for pickling.

When made into a preserve with pumpkin or the rind of the water-melon, a little of this fruit imparts the flavour of stewed apples, or of the fruit in an apple pie.

The kei-apple thrives perfectly on the Queensland coast, and cannot well be surpassed as a hedge plant. A specimen of its capabilities in this respect may be seen at Bowen Park.

LITCHI.

(*Nephelium Litchi.*—SAPINDACEÆ.)

The order to which this tree belongs comprises many individuals which are unquestionably poisonous in their leaves, branches, fruit, or seeds. The Litchi, however, the Longan, Rambutan, and Dawa are perfectly safe eating, as are also some of the fruits of other genera of the order. The seeds in all cases are better let alone, a very easy thing to do, as they are all too large to be conveniently swallowed.

The litchi is a small tree, attaining about 20 feet in height, with close handsome foliage. It likes a damp climate and abundance of water, and will thrive under a considerable range of temperature. Fortune, in his "Wanderings in China," speaks of the litchis as very beautiful when covered with their fine red fruit; the fruit contrasting so well with the deep clear green foliage.

It is believed to be a native of Southern China, but is so commonly cultivated in China that its precise original habitat has been lost. In India, Ceylon, Mauritius, and other warm climates, it is also in common cultivation; but there is a marked difference in the excellence of the several varieties grown.

In India, litchis of the finest quality and most delicious flavour are grown. Owing, however, probably to the earlier introductions having been inferior kinds or mere seedlings, there are many trees about Calcutta the fruit of which is comparatively valueless. This circumstance is important to be noted by the Queensland gardener, as many hundreds of seedling litchis have been distributed in the colony; and from the produce of some of these it is quite possible that an erroneous impression may be formed of the true qualities of the fruit.

The largest varieties are not necessarily the best. Those which have fruited at Bowen Park, and which have been pronounced excellent, produce a fruit in size and shape precisely similar to those commonly imported in a dry state. When fresh the inside pulp is of a nearly transparent white, like jelly, sweet, with a delicate subacid flavour and pleasant aroma. The seed is a largish smooth brown stone, which comes away easily and clean from the pulp. That the fruit is perfectly wholesome is evident by its enormous consumption in countries where it is a common product; and by the fact that it is so subject to the ravages of birds that the trees require protecting with nets.

The sundried fruits are largely exported from the Canton provinces, being in some demand as a marriage present, or for dessert at feasts.

The litchi has perfected its fruit under glass in England, where it was introduced by Warren Hastings as far back as 1786. The dried fruits may often be seen in the windows of London grocers' shops.

The leaves are reputed to possess virtue as a remedy for the bites of animals.

As the tree does not come true from stones, it is best to propagate by grafting or layering.

LONGAN.

(*Nephelium longanum.*—SAPINDACEÆ.)

This is a tree of much the same size as the litchi, originating in Southern China, but also stated to be indigenous to India. The fruit is smaller, and its exterior less rough, the principal resemblance being in the semi-transparency of the pulp. There is less pulp to stone than is the case with the litchi, and, as a fruit, the longan is decidedly the inferior of the two. So marked, indeed, is this inferiority that in China the longan is called "the slave of the litchi." As a set-off, however, the Chinese, who compare it to "dragons' eyes," attribute to it the qualifications of being nutritious, a good stomachic and anthelmintic, and also as quickening the memory and intelligence; "a remedy," drily observes my authority, "much needed in China."

This fruit is more easily raised than the litchi, as it comes true from the seed.

MAHWAH TREE.

(*Bassia latifolia.*—SAPOTACEÆ.)

A handsome tree attaining a height of from 40 to 60 feet, and girth of 6 to 7 feet. Trunk straight but short, with a smooth ash-coloured bark, and branches numerous, the lowest ones spreading horizontally. It is native to and common in most parts of India, and is largely protected. It is also to some extent cultivated, possessing the advantage of thriving in dry stony ground unadapted for the plough, and of producing a crop of unfailing certainty. The flowers are numerous, crowding at the extremities of the branchlets on a footstalk about an inch long. They generally appear between the shedding of the old leaves and the opening of the new. The crown of the tree is close, shady, and rounded. The fruit is the size of a small apple, one to four seeded, but the seed like those of most of the genus are perishable, and will only carry successfully sown in soil.

The mahwah is one of the few trees the chief economic value of which lies in the flowers. The corolla in this case is thick and fleshy, with a sickly sweet taste like that of manna, and is very nutritious. The flowers are borne in great profusion, and, being very deciduous, thousands of tons of them fall to the ground in the season, and are feasted on by the forest birds and beasts. During the day before they fall, birds, squirrels, and other tree-resorting animals feed upon them largely. Deer, bears, pea-fowl, jungle-fowl, and creatures of all kinds eating vegetable food, take their fill either from the tree or at its foot, and when the number of these depredators is considered in connection with the fact that there is an abundance left for the wants of man, the productiveness of the tree may be understood. A single tree will produce from 200 to 400 lbs. of flowers, without any other trouble of harvesting than gathering in the early morning off the ground where they have fallen during the previous night.

The fondness of many kinds of animals for the mahwah is taken advantage of by sportsmen and hunters, white and native, to get within range; and many a deer, bear, and bird fall victims to the engrossing nature of their occupation when feeding on the falling flowers of this remarkable tree.

The season of the mahwah lasts for two months, but as the flowers dry and keep well large quantities are stored and constitute a staple article of food. So dependent indeed upon it are the native population in some districts that, in expeditions undertaken for the punishment or subjection of unruly tribes, the threat to cut down their mahwah trees often operates to bring them to their senses without resort to arms.

The use of the mahwah is by no means confined to the localities of the trees, but they are carried long distances for sale in the bazaars, and are eaten both raw and cooked. As a food for cattle they are extremely useful and are in much request, and mahwah-fed pork has a very high character.

The "Journal of Applied Science," referring to an importation of mahwah flowers, by a New York house, from Calcutta in 1880, says that the sample as imported shows a soft sticky mass, having much the appearance of raisins of a poor quality, such as are packed in casks. When soaked in water the individual corollas swell out and assume a flattened globular shape, and are found to consist of a very fleshy cup within which are a great number of anthers. The consignees having had an analysis made, the report shows that the flowers contain the remarkable amount of 63·40 per cent. of sugar. This enormous percentage of sugar, without reference to other constituents, fully accounts for the value attached to the flowers in India as an article of food and for use as a source of spirituous liquor.

The fruit is of the size of a small apple, one to four seeded, and is eaten both ripe and unripe. Its chief use, however, consists in the extraction from the seeds of a greenish-yellow oil, which concretes rapidly after expression, and retains its consistency at a temperature of 95°. In a cold climate it keeps a long time, but in the plains of India, after a few months' exposure, it gets a bitter taste and rancid smell, separating into a heavy brown deposit with a little clear fluid above. The oilcake is used for stupefying fish, and the smoke from its combustion is said to kill insects and rats. The fresh oil is used in coarse cookery, in the manufacture of soap, and for burning. The value of the oil in London for the purpose of making candles is about £35 a ton.

Having described the more innocent uses of the mahwah, I come to it as raw material for the distillation of an enormous quantity of a coarse strong spirit. This is a large industry from which the Government of India derive a considerable revenue. In 1875 an excise duty of 8s. was paid upon every hundredweight of mahwah flowers entering the distilleries; but this charge was based upon the belief that the quantity of raw material named was only capable of producing three gallons of proof spirit. Since then, however, the yield has been found nearer six gallons, and the duty has been increased. The Parsees seem to be the great distillers and sellers of this spirit between Surat and Bombay, pushing their distilleries and shops into the very heart of the districts where the tree is most plentiful. The extent of the industry may perhaps be judged from the fact that the Government revenue from this source, in one small island off Bombay, reached £80,000 a year some years ago. Apart altogether from the regular manufactories, large and small, distillation from the mahwah is carried on among the tribes, with all sorts of rude appliances, for home consumption.

The first product contains an essential oil which gives to the spirit not only a peculiar and somewhat fetid flavour and smell, but imparts to it a deleterious quality. Some years since a patent was taken out for the removal of this material disqualification, the result being a spirit free from smell, and nearly, if not quite, equal to the best French brandy; but the influence of the rum distillers of Calcutta is stated to have led to the imposition of a prohibitive duty which completely put an end to the manufacture of the pure scentless spirit, and this in face of the facts that the process was cheap and simple and the product a wholesome spirit. It is fortunate that, as in the case of rum, age greatly improves the mahwah spirit.

The timber is not much used, as the tree for obvious reasons is not often cut down; but it is very good, being close, durable, and tough.

Too much stress can hardly be laid upon the value of this tree for Queensland. It thrives in stony poor soil, and its crop *never* fails; the season never having been known in India when the crop of mahwah flowers was not abundant. The simplicity of the method of harvesting of the crop, and its extraordinary keeping qualities for whatever of its numerous uses it may be wanted, contrast the mahwah favourably with many of the plants upon which so large a number depend for their living, and the partial failures of which so frequently involve them in difficulty.

MANGO.

(*Mangifera indica.*—ANACARDIACEÆ.)

This is a large evergreen tree, a native of India, and is cultivated generally in the tropics. That it matures its fruit, also, successfully and abundantly in semi-tropical climates we know from our own local experience. There is a considerable difference between the size attained by the tree in its natural and in the cultivated state. The wild mango, when found under favourable circumstances, is a stately tree with noble foliage, having a massive crown giving dense shade. It attains 15 feet in girth, and 60 to 70 feet in height, and has an erect trunk with a dark scaly cracked bark, and lance-shaped leaves. The flowers are white, in long loose bunches at the ends of the branches. It reaches an elevation of 4,000 feet above the level of the sea, being generally found in ravines and on the banks of streams.

The cultivated tree propagated by grafting becomes dwarfed in character to an extent which permits it to find room in the orchard and garden; and while it often makes a handsome object, it never attains dimensions which permit of its being described as a large tree.

In Queensland, the mango flowers during the last four months of the year, and ripens its fruit during the following three, although in exceptional seasons the writer has seen ripe mangoes at Christmas. The mango is most variable in the length and breadth of its leaves, and in the form of its panicles of flowers; and the cultivated varieties not only evince this peculiarity, but it is also remarkably observable in the fruit also, which differs much in size, shape and colour. The prevailing form is oval, somewhat flattened, and in many cases approaching kidney-shape. In size, the fruits vary from that of a pullet's egg weighing 2 or 3 ounces to that of a small pumelo of over 2 lbs. weight. In Brisbane the writer has seen ripe mangoes no larger than a "magnum-bonum" plum, and others which have weighed 26 ounces. The colour of the fruit when ripe is also variable, some being orange, others a bright yellow, and others a combination of one of these colours with green. Some varieties do not change colour at all in ripening.

In the light of securing good varieties the mango is not an easy tree to propagate. As it does not graft readily if the scion is detached, the method almost always resorted to is that of inarching. To provide stocks, selected stones are sown when the fruit is in season, and when fit the plants are potted off singly. By the end of the second year they are fit for inarching, which, in India, is done upon the setting-in of the rains. At the close of the rains the union is complete, and the new plants are separated and removed to some shady spot for another year to strengthen before being planted out. It will be seen at once, in view of the small number of specimens of named varieties in Queensland from which to graft, how very slow this, in itself slow, process must be to produce any

considerable number of fine kinds of mango in the colony. A new method of propagating the mango is now being tried in India; but opinions somewhat differ as to its efficacy, and I fear that in Queensland the dryness of the atmosphere would present a considerable obstacle to success. The method is thus described:—

"The seedling, with seed attached thereto, when it is about 6 or 8 inches high and three weeks old, is carefully lifted with a small ball of earth. The roots, with the earth intact, are then wrapped up in a little grass, and the young seedling plant tied to the tender branch of the tree required to be grafted from, care being taken that the young seedling tree and the branch to be grafted should lie pointing in the same direction, and be of the same age—*i.e.*, both seedling and graft should be of that year's growth. When grafted, the join should be covered with grafting-clay to exclude the air.

"2. The roots of the seedlings, suspended as above described, when grafted, must be kept moist by watering, either by hand or with a garden syringe, in case there be not sufficient rain.

"3. The process of grafting should be commenced in the beginning of the rainy season, as soon as the young mango seedlings are procurable. The plants should be ready for cutting, *i.e.*, the graft should have taken well within a month; the graft should be partly severed at first, and completely severed a few days afterwards; but I have succeeded in cutting them so soon as thirteen days after grafting, and the plants so removed are now in good growth in the nursery—in fact, plants thus grafted in this season are now growing strongly and ready for sale. The plants grafted in this way on young wood, where the junction is so complete, will, in all probability, be much stronger than those grafted on two or three-year-old plants; where, the wood being hard between the grafts, such a complete union is impossible, from which cause a great number of the plants die or are broken down by the wind." Grafted mangoes come into bearing in about five years after planting out.

It becomes thus a question of peculiar importance in this country how far the mango comes true from seed, and what proportion of seedling plants may be relied upon to bear good medium or high-class fruit. It appears to be an admitted fact in India that in some parts, especially in Burmah, the seeds of good kinds of mangoes produce good fruit of similar characteristics to the parent; and there are individual trees which invariably come true from seed. The favourite statement, at one time made by all old Indians, that a good seedling mango was an impossibility, has been long exploded; the quite modern experience of this colony proving the contrary. There can be no doubt, however, that, both in the quality of their fruit and in bearing capabilities generally, seedling mangoes are uncertain; and it will, therefore, save much time and disappointment by increasing the chance of growing good kinds, if none but the stones of good kinds are sown. The natives of India recommend preparing the seed by skinning the fruit, leaving the pulp intact, and throwing into milk for three days before sowing. There is no doubt that seedlings will often grow with a rapidity, uprightness, and vigour, bearing a remarkable comparison with grafted plants in the immediate vicinity. The seeds of the mango often contain more than one embryo, and the writer has known as many as six distinct plants from one seed, although varying much in strength.

The quality and characteristics of the fruit vary quite as much as the form and colour. The "tow and turpentine" comparison take their origin from the presence in excess, in inferior fruit, of a turpentine flavour and of strong hairy fibre attached to the stone. In proportion as these disqualifica-

tions are absent in the ripe fruit does its classification for excellence mainly depend; but there is still much difference in flavour, juiciness, and consistency. After removing the outer skin, which peels easily, a good mango should be of a soft creamy consistency, capable of being eaten off the large central seed with a spoon; but while this is generally regarded as one of the highest tests of quality, there are many seedling fruits quite free from turpentine, of delicious flavour, and full of juice, but which, owing to the presence of fibre, can only be eaten by suction, and are unfitted for table. The perfume of the ripe fruit is indescribably delicious.

It is impossible to describe or enumerate the named varieties of mango. The Agricultural and Horticultural Society of India publish a list of forty-three kinds, of which they sell grafts; and in Java something like forty are known. There are also to be found in the gardens of the wealthy in both countries, trees, without names, producing fruit of exquisite flavour; and so highly are these often prized by their owners that while the crop is ripening guards are set over the trees. There is no doubt that the mango is one of the greatest delicacies of the vegetable world, and rivals any other known fruit, even the much-lauded "mangosteen."

The green fruit is used in various ways—for pickles, chutney, and as a preserve. Both the unripe fruit and seeds are also put to various medicinal uses in cases of ophthalmia, eruptions, and asthma; the kernel being held in high repute as a remedy for worms. In Jamaica starch is extracted from unripe mangoes. In times of scarcity the seeds, after having been boiled or steamed, are used as an article of food in India. Boiled in brine they are used as olives; and boiled and served with vinegar and pepper, they take the place of cucumber as a salad. When brought to table, cooked in puddings or dumplings, they have a near resemblance in taste to apples.

The timber has little value except for the commonest purposes, being perishable and easily attacked by insects; but the small heart-wood of large trees is occasionally used for cabinet work. A gum exudes from the bark, which is somewhat astringent. With lime-juice or oil it is useful as an application in skin disease; and taken internally it is valuable for diarrhœa, as a remedy for which the bark of the root is also used.

The medicinal virtues of the mango, as attributed by Lunan 70 years ago, I prefer giving as a quotation for what it may be worth:—"In the East Indies the tender leaves, with the bark of the castor-oil plant and cumin seeds, are made into a decoction, which is thought highly beneficial in cough or asthma, and other affections of the thorax. The stones roasted are said to cure looseness, which Garcias found to be true. The stalks calcined and reduced to powder are said to cure warts. The bark of the tree pulverised, and taken with chicken broth, is an excellent dissolvent of extravasated and coagulated blood, occasioned by a fall, in any part of the body. The juice of the bark, with the white of an egg and a very little opium, taken inwardly, is a present remedy against diarrhœa, dysentery, and tenesmus. Of the gum of the tree, and flour of rice, with the addition of a small quantity of opium, are prepared pills, which also cure all sorts of fluxes of the belly. Of the flour of the dried kernels the natives have the art of preparing various kinds of food."

A good practical authority on Indian horticulture recommends during the resting reason of the tree that the roots should be laid bare for 2 or 3 weeks, after which they should be top-dressed with a plentiful supply of manure, and be covered in with fresh earth. When the fruit is swelling copious drenchings of the soil about the tree with water are strongly recommended.

The productive mango crop is considered by the natives of India to indicate an unhealthy season, and there is doubtless a connection between this theory and the advantage derived by the application of abundant waterings to the maturing crop.

MESQUIT, ALGAROBA, or SCREW BEAN.

(*Prosopis pubescens—P. juliflora.*—LEGUMINOSÆ.)

The terms "Algaroba" and "Mesquit" are used as the vernacular for more than one species of *Prosopis*; nor would it appear that specific scientific names have yet been allotted to the several kinds. Thus we find *P. juliflora*, *P. glandulosa*, and *P. dulcis* described by some authorities as one and the same tree, and by others as distinct species of the genus.

The two species *pubescens* and *juliflora* were introduced to Queensland by those names under the authority of Sir Joseph Hooker, so we may with perfect safety accept them as correctly named. If there be no other distinction between these two than that of the form of the bean, they differ so much in that particular that it is impossible for confusion to arise. The seed pod of *Prosopis pubescens* is round, and is contorted like a ram's-horn; and from that peculiarity obtains its common vernacular name of the "screw-bean." The pod of *P. juliflora* is flat and more or less scimitar-shaped like the culinary French bean. Whether *P. glandulosa* and *P. dulcis* are identical with this latter species or not is immaterial to my present purpose, as their habit of growth and the value of their products are very much alike. Plants of both species were raised from the Kew seed by the Acclimatisation Society, and were largely distributed. I have not been able to trace the progress of the screw-bean; but have handled and tasted fruit of *P. juliflora* grown at Bowen Park last year.

The literature of the screw-bean, or Tornillo, is scant, although it is probably mixed up in some degree with that of the other species. It was first brought to public notice in a despatch dated 10th May, 1875, from Consul Kirkwood to the Earl of Carnarvon. Mr. Kirkwood refers to a statement made by Lieutenant Whiffle in his diary of a survey of the line of boundary between San Diego and the point opposite the junction of the Gila with the Colorado River. This statement is to the effect that the prosperity of his horses and mules and the success of the expedition were expected to depend on this mesquit or screw-bean; that the screw-like pods grow in clusters eight or ten upon the same stem; that the pods contain much saccharine matter and are very nutritious; that they ripen at different seasons of the year; and that they are very abundant, each tree producing many bushels. Mr. Kirkwood's letter being communicated to Kew, Sir Joseph Hooker replied "that two distinct plants are known by the name of "mesquit bean," one in the eastern and the other on the western part of the Southern United States, and that one or both yield good timber, charcoal, a gum equal to gum-arabic, and pods full of nutritious matter that has been used for food by man and cattle, and proved of great service to exploring parties." Upon Sir Joseph Hooker's advice, the Colonial Office obtained seeds of both species, and these were distributed from Kew for planting in the drier regions of the Colonies of South Africa and Australia.

The suitability of the pods of these trees as fodder for horses has been questioned. The U.S. Department of Agriculture suggests a doubt whether Lieutenant Whiffle did actually feed his horses on mesquit pods, and gives an instance of a fine horse in Jamaica which was killed by eating

about a pound of these pods; but admits that they seem to be used safely in their native habitat. Baron Mueller says that the pods of the various kinds of *Prosopis* are adapted as food only for such animals as chew the cud and thus get rid of distending gases. Their unwholesomeness is attributed to the germination of the seeds in the stomach of the animals. The truth probably is that horses at large where the tree is growing eat the pods, in conjunction with other growing fodder, without injury; while the pods if fed to horses injudiciously will produce gripes.

Mr. Justice Judd, writing to me from Honolulu, thus speaks of *Prosopis juliflora*, known there as the "algaroba":—"We find the algaroba to be most valuable, as it grows in our localities without irrigation, where no other tree will grow. It is not suited to a damp locality, nor will it grow well on the windward side of our island exposed to the strong winds, especially if they are laden with salt spray. On the leeward side, however, where there is some shelter from the strong trade winds, the tree grows very rapidly. Its wood is hard but brittle. It will kindle and make a bonfire when fresh cut. The pods are the best of food for cattle of all kinds: you need not fear that horses or cattle will be injured by its free use, as they soon know when they have had enough. It would be well at first to give only as much as its bulk in the ordinary feed of other grain. When animals are in a paddock where these trees are, they pick up the pods as they fall, and you may see animals standing under a tree waiting for the pods to fall off. The tree sends its roots along the surface of the ground, and is often prostrated by our high winds and broken off, but springs up again. It will stand any amount of trimming and abuse of all sorts."

I am indebted to Mr. John Scott, my successor in the office of Vice-President of the Queensland Acclimatisation Society, for the following extracts from letters written to him by an old resident of Honolulu, who having visited Queensland formed the opinion that the algaroba was well adapted to our climate. This gentleman says:—

"Here the algaroba is growing in great quantities all over the place; everyone says it is a great boon. Mr. ——— has not bought firewood for three years, or any food for his horse, and the trees make a delightful shade.

* * * * * * * * *

I am glad to hear the algaroba seeds have come up; plant them in your paddock, and guard them from the cattle till fairly grown up; they will not take long to become trees, and will soon cover your place with firewood and horse-feed. It is quite wonderful what a forest has grown up here in five years. The pods falling from the trees spring up and spread themselves—it is only just at first you have to protect them. I hope they may grow well in Queensland, and become as great a benefit to you as they are to this country. Be sure to prune off the lowest branches when they begin to grow straggling, so as to make the trees tall and straight. They will grow to the height of 30 feet, and always look best and cast the best shade when tall and not too bushy. The plant is a native of Peru. Cattle, fowls, pigs, &c., all fatten upon the food, which is of a glutinous, sweetish nature, reminding one of oil-cake."

Being still unsatisfied upon the point of the wholesomeness of the algaroba as a food for horses, Mr. Scott was good enough, at my request, to write specially upon the subject to his Honolulu correspondent, who replied as follows:—"In the matter of the seed pods of the algaroba as food for horses, I will say that it is just as safe food as oats or Indian corn. It would not do to let a hungry horse eat his fill of either of these things. In Peru we used to give the horses a measured quantity twice or three times a day, giving them at the same time alfalfa, or hay, *ad libitum*, but the animals

running loose lived upon the algaroba exclusively, and no harm came to them, except that of getting into a splendid condition. Here the horses and cattle pick the pods up under the trees as they find them in the paddocks, and I have never heard of any harm coming of it. When a horse gets too much of this food he becomes very excitable, and I think it affects his sight. At least, I know a horse which is usually quite steady will shy like anything when he is getting lots of algaroba."

The following account of the uses to which the products of the algaroba are put by the North American Indians is taken from a report of the United States Department of Agriculture :—" The bean-like production of this common tree of the deserts is an important article of food with the Indians living within its reach. The pods, 7 to 9 inches long, of a buff colour, ripen in June sufficiently for summer use, and travellers, both Indians and whites, chew them as they journey on. They are not only nutritious, but a preventive of thirst, having an agreeable blending of acidity and sweetness, somewhat like an early harvest apple. The pods, when in their fresh ripe state, are put into a wooden or stone mortar and bruised, then emptied into an earthern dish, mixed with water and allowed to stand a few hours, the result being a kind of cold porridge or mush. All present then collect round the newly prepared mess, seating themselves on the ground near the dish, and, pressing the fingers of the right hand tightly together, at the same time bending the hand so as to form a scoop, dip in without ceremony, and without distinction of rank, age, or sex, forming a grotesque sight rarely to be witnessed outside of an Indian camp. The nearly naked bodies of the Indians soon become smeared from head to foot, and the saggy appearance of their hair does not exhibit a lively sense of cleanliness. Each face wears a complaisant look, while their tumid abdomens afford certain proof of the quantity consumed. As the fruit or bean-like pods ripen they are gathered for winter use, being thoroughly dried and stored in cylindrical-shaped baskets, made of twigs and covered with grass and earth to keep out rain, in which shape they may be preserved a long time. They form a sweet nutritious food, and are among the great luxuries of the Apaches, Pimas, Maricopas, Yumas, Yavapais, Mohaves, Hualipais, Cocopahs, and Moquis of Arizona, besides many tribes of New Mexico, Utah, Nevada, and the southern portion of California. The Indian women pound the dry pods until reduced to a fine powder, which, being mixed with a little water, is pressed into large thick cakes of several pounds' weight and dried in the sun, to be used as circumstances require. They are often kept in the pulverized state in bags or stored as pods, but if not thoroughly pulverized so that the seeds are as fine as the pulp they will soon become a living mass, since from every seed will come forth an insect, a species of *bruchus*.* This, however, makes little difference to the Indians, who do not pick the insects out but let them become an ingredient of the bread. If reduced to fine flour the larva of the insect becomes a part, forming a homogeneous mass of animal and vegetable substance.

The flour, being very sweet when mixed with water, forms an agreeable drink, and when made into gruel is very palatable. If boiled in water and fermented a very pleasant and nutritious drink, much esteemed by the Indians, is the result. When the crop of mesquit beans fails there is great suffering among the tribes. Excellent vinegar can be made from the pods ; and horses and cattle soon grow fat by eating them. The gum which oozse out of this tree, when perforated by insects, is often eaten. All the Indians of Arizona mix this exudation with mud, which is then daubed over the

* This liability to insect attack renders it difficult to import sound seed. Not more than a fifth part of the seed of either species sent to Queensland from Kew was good.

entire head, serving two purposes—killing all the insects, and rendering the hair very black and glossy; it is, in fact, very good hair-dye. The women use the bark of this tree to make skirts, and twist it into rope or twine, and even weave it into baskets.

Leaving on one side the botanical question of exact species in different localities, trees known as "algaroba," all with the same characteristics as to products, and in all probability identical except in some unimportant specific distinctions, are indigenous to Jamaica and the dry regions of South America, as well as to the Southern States of the Union. In California and Texas the tree is known indifferently as "cashaw," "mesquit," "algaroba," or "honey mesquit"; and it holds a very prominent place in the forest growth of those regions. It is officially described as a short spreading tree,* shaped like an apple-tree, varying in size from a small shrub to a trunk 18 inches in diameter, bears pods 7 inches to 10 inches long, which contain about a dozen beans, surrounded by a sweet pulp, as in the honey locust; is eaten by Indians and often by white men, but chiefly used as food for horses.

Fences made of this timber in Southern Texas have been known to stand in a perfect state of preservation for more than fifty years. It resembles *lignum-vitæ* in hardness and durability, and takes a polish like mahogany.

Not only the bark, but the whole body of the tree, is rich in tannin; an analysis of shavings of the wood, made by the United States Department of Agriculture, showing that, as compared with other tanning material, it was very valuable, yielding a considerably higher amount of tannin than many other sources.

A gum, much resembling gum-arabic, exudes in considerable quantities from the tree, and is by no means an unimportant product. In Texas alone, ten years ago, 12,000 lbs. of this gum were exported, while it was also largely used in the home market for various technical and medicinal purposes, such as gum-drops, jujube paste, mucilage, etc.

I have said that *Prosopis juliflora* fruited at Bowen Park last year, and it is probable that seeds or plants can be obtained on application.

MONSTERA DELICIOSA, or TORNELIA FRAGRANS.

(AROIDEÆ.)

Unfortunately I have no simpler name to give my readers for this admirable modern addition to our gardens. The generic name—*Monstera*—is not even explained by any authority that I can discover; but no one who has once eaten the fruit need be at a loss for the origin of the specific name *deliciosa*.

The plant, originally from Mexico, was first sent to Queensland, through the Acclimatisation Society, from the Royal Gardens of Kew. It is an epiphytal climber, sending out long aërial roots, which it loves to wrap round the stem or branches of the tree to which it is attached, in the same manner as the allied *Philodendrons*—which derive their name from two Greek words indicating the same habit.

In our gardens the plant is not by any means a rampant climber; one stout hardwood sapling, three to four inches through, and five or six feet high, being ample for its support.

* Griesebach, in his "Flora of the British West Indian Islands," says that *P. juliflora* attains a height of 30 to 40 feet, although sometimes reduced to a dwarfish shrub.

The fruit, which remains on the plant for twelve months before ripening, is in form like an elongated pineapple, and matures during February and March. The approach to maturity is not indicated by any change of colour, but by the drooping of the fruit upon the stalk and by the external scales near the footstalk commencing simultaneously to peel off. It should then be cut; but, as it only ripens gradually to the apex, it is necessary after eating such portion as is ripe to put the remainder away for another twenty-four hours. It is a really delicious fruit, and well worth cultivating; but as its excellence depends wholly upon its being quite ripe, the foregoing instructions should be kept in mind.

Eating the fruit is sometimes accompanied by a slight tickling sensation in the throat, caused, it is thought, by the needle-like form assumed by the sugar crystals contained in the juice. The sensation, is, however, only temporary, and leaves no irritation behind it.

The *Monstera* can be propagated from seed; but as many of the fruits have no seeds, and seedlings are remarkably slow of growth, it is better to cultivate from layers or cuttings. The simplest and quickest method is to allow a plant to run along the ground instead of training it upwards. The roots, which would otherwise be aërial, will then find their way into the ground; and by passing a sharp knife between the joints, as many plants will be obtained as the length of the prostrate stem permits.

The *Monstera* has been widely distributed along the northern coast, and ought to be found in many gardens. The habit of the plant is to thrive best in damp, shady spots, in a rich soil; but as a matter of fact it has been successfully fruited at Bowen Park under conditions the very reverse of these.

The way in which the thick aërial roots will find their way to water is curiously instanced by a specimen in an orchid-house in the old country. The plant is growing attached to a wall. Sunk in the floor of the house is a water-tank, and to this a pair of the roots have made their way along a shelf until they came to an opening, whence they descended into the tank. When there, and to show their thorough appreciation of the position, they each developed a mass of rootlets described as looking like a pair of circular brushes.

NUTMEG.

(*Myristica fragrans.*—MYRISTICACEÆ.)

The name of *Myristica* is founded upon the Greek word for "Myrrh," and was given to the genus on account of the odour of its fruit, in which regard, however, there is a material difference in the several species. The odour is most intense in that under review. The commercial value of the fruit depends upon the degree in which the essential oil producing this perfume is present.

There are more than thirty species, chiefly natives of tropical India and America, and of the Malayan Archipelago, one* being common in sub-tropical Queensland. The true nutmeg of commerce is confined to the Moluccas and neighbouring islands, although it has spread by naturalisation to the western coast of India, to Java, Sumatra, Penang, Mauritius, Bourbon, Cayenne,

* *Myristica insipida* a fine tree of 60 to 70 feet or more, found from as far south as Rockhampton, along the entire coast, to the Gulf of Carpentaria.

Martinique, and some of the West India Islands. It is also grown in the province of Canton, in China; but is seldom used as a spice by the Chinese, being employed medicinally as an astringent, anti-spasmodic, stomachic, and anti-vinous remedy.

Its spread has in some measure been extended through the agency of fruit-eating pigeons, which, after divesting the fruit of its fleshy covering, swallow the nut with its mace, and digesting the latter void the nutmeg in its shell. These falling on congenial soil, in a warm, moist climate, readily germinate, and either grow to maturity and produce where they are thus sown, or are removed in a young state to take a place in regular plantations.

There are a number of other fruits bearing the designation of nutmeg, which are the produce of trees of wholly distinct orders, but they have no important commercial value. The so-called nutmeg-wood is the timber of the Palmyra Palm.

The true nutmeg is a handsome straight-stemmed tree, attaining under favourable conditions a height of 40 to 50 feet, with a much branching head. The bark is smooth, and externally of a dull ash-colour, interspersed with green. Internally the bark is red and succulent; if wounded, emitting an acid viscid juice of a blood-red colour, which leaves an indelible stain on linen. The leaves, which are highly aromatic, are 3 to 6 inches long, resembling those of a Pear-tree, dark-green, and glossy on the upper surface, but of a pale-grey colour beneath. As an almost invariable rule, the male, and the female or fertile, flowers are produced on different individuals, creating necessary special features in the method of cultivation; although it happens occasionally that both forms of flower are found on one tree. The flowers, which are bell-shaped but insignificant, are of a yellowish-white colour, and are found on footstalks at the axils of the leaves. The tree bears throughout the year, the same individual having flowers and fruit in every stage.

The fruit, which takes nine months to mature, has then the appearance of a small peach, somewhat pointed at the end. All round longitudinally it is marked with a furrow. Externally the fruit is smooth, green when young, but at maturity, like the peach, acquiring more or less of a red tinge. When ripe it opens at the furrow, displaying the nut in its black shell, covered with a bright crimson leafy network which constitutes the familiar mace; so tightly does the mace cling as to leave its impression on the surface of the nut. The fruit at this stage is extremely beautiful; our native nutmeg, pretty as it is, affording but a faint idea of the charms of the head of the family. The fleshy part of the fruit is about half-an-inch thick, yellowish-white inside, and very astringent.

The unripe fruit, as well as the fleshy covering of the mature fruit, is often preserved in sugar in the East; but before doing so it is necessary to deprive it of its acrid properties by soaking in spirits.

The nutmeg is propagated for the formation of plantations, or "parks," as they are called, by seed or layers, but principally by seed. As already stated, the young plants which grow from the sowings of the birds are largely availed of, being transplanted usually about the third year; but the nutmeg is a manageable tree in the matter of transplanting, and with care may be removed at a much older stage. In making a nursery, well-ripened selected nuts are sown a foot apart in rows, being only lightly covered with soil. They take from 30 to 60 days to germinate, shade and moderate watering being essential elements of success. When from 3 to 4 feet high they are removed to the plantations, where they are set from 25 to 30 feet apart. In dry weather the trees are watered, and they benefit immensely by the surface of the ground, especially over their roots, being mulched with any material which can afterwards be advantageously turned in.

A strong, rich, and rather moist loamy soil is best suited to the Nutmeg. Poorer soils are used in connection with an unwholesome system of repeatedly applying stimulating manure in immediate contact with the roots; a system which forces the tree into a condition of abnormal growth and productiveness, but ultimately weakens its constitution and results in premature death. In Singapore for upwards of twenty years the cultivation of the Nutmeg was carried on extensively and with most profitable results. The soil of the island being naturally poor, the planters forced their trees into an unnatural luxuriance by digging trenches round them a foot deep and wide, and filling with cowdung. During that period plantations changed hands at high prices and much money was made in connection with the industry. "In the year 1860, however," says a writer in the Linnean Society's Journal, "a sudden destruction came upon the trees, from an unknown quarter. To the dismay of the planters there appeared among the trees (which up to that time had yielded magnificently) a blight whose destructive effects could not be arrested, while the source of it defied all inquiry. In the night a tree would be attacked, and the morning light would show its topmost branches withered; the leaves fell off; the disease slowly spread downwards, chiefly on one side of the tree; and, in spite of every attempt to check it (the lower portion often being for a long time green and bushy), the tree became an unsightly mass of bare and whitened twigs. Most trees were entirely stripped in time, and became mere skeletons. Large outlay was expended in the endeavours to arrest the destruction, but it was all thrown away. No situation was exempt from its ravages, hills and valleys alike suffered, nor could any principle be traced in its promiscuous attacks. Upon a close examination of diseased parts it is found that the formative layer inside the bark dries up and turns black, the leaves then wither and fall of, and soon the bark is found to be full of small perforations, but no insect of any kind has ever been discovered in connection with the change, nor has any fungus been charged with the destruction. Its nature has been a mystery and a puzzle to the planters, who have, for the most part in vain, sought for a cause, either near or remote, and whose efforts to arrest it have proved entirely unavailing. I have heard various suggestions offered, some of them of the wildest character, to account for the disease. That which my friend M. Jose d' Almeida proposes is by far the most reasonable, and in fact commends itself to the judgment of the vegetable physiologist. It is that the trees had long been unnaturally forced by digging trenches too closely around their spongioles, and by too rich and long-continued manuring, by which heavy crops, it is true, were for a time obtained, but which at last exhausted the tree, so that the premature decay thus brought on by inflexible physiological laws was incapable of being arrested by any after treatment."

"When it was found that, in spite of care and lavish expenditure, the trees surely died, a reaction took place. The planters abandoned the plantations in disgust, in many cases while there were still numerous healthy trees, and the land reverted to the Government. Many planters, both English and Chinese, whose whole estates were invested in nutmeg plantations, were thus reduced to ruin and became absolutely penniless, and distress and disappointment everywhere prevailed. It is a curious fact that many of these abandoned trees, around which has now sprung up a thick jungle undergrowth, have, since they have been thus neglected and left to themselves, *recovered*, and relieve the generally dismal prospect of bare branches and skeleton trees. I have myself seen these dark-green healthy trees in many situations where they are quite uncared for, even among the oldest plantations in the island, and this fact seems decidedly corroborative of the idea that the disease was one of exhaustion and decay, arising from unnatural

forcing. Another fact is significant, viz., that at Penang, where this cultivation as described was carried on with the greatest vigour and the greatest expenditure, the destruction has been most complete and marked, while at Malacca, where the people were not so rich and could not afford to manure the trees so highly, they have not suffered so severely as at Penang and Singapore."

"At the present moment there is no such thing as nutmeg cultivation at Penang or Singapore, nor does it seem probable that the experiment will be again tried. Planters are now persuaded that neither the soil nor climate are favourable for their production, and other crops have fared but little better. The trees which still exist are neglected and abandoned by their owners, though they still yield nutmegs. These are gathered by any Chinese or Malays who take the trouble to do so, and the few nutmegs, insignificant in quantity, which now find their way into the Singapore market are obtained in this way—a clear gain to those who carry them there."

Screening the trees from extreme heat and from violent winds is essential. This is done by allowing a sufficient number of the natural trees to remain, or by the regular planting of shade trees, as in the case of the Cacao and sometimes of the Coffee tree.

The circumstance that the male and female flowers are produced on separate individuals renders it difficult to create plantations the whole of the trees of which shall be productive. The plan adopted in the best arranged plantations is to head down all the plants at about two years old, and to graft them with scions from healthy female trees, leaving a very small proportion of male trees for fecundation. At the earliest the nutmeg does not flower, and the sexes cannot therefore be distinguished, before the sixth year; and where the method of grafting is not adopted the superabundant males are then removed, and other seedlings or layers from female trees are substituted until the entire plantation consists of productive specimens. The trees which bear latest are considered the best, and skilled growers do not allow their trees to bear before the ninth year, which is, in fact, about the time at which, as a rule, they show a disposition to fruit. The produce is variable. The average in the Straits probably does not exceed 1,000 nuts per tree, although exceptional trees forced with manure will bear ten times as many. It is computed (says Porter) that each female tree, when at full maturity, will yield, under careful culture, 10 pounds of nutmegs and about 1 pound of mace annually. The trees continue productive for seventy or eighty years.

As has been said, the Nutmeg tree bears all the year round, but some months more plentifully than others. The crop is gathered three times, the periods varying under the different conditions of climate and season. In the Moluccas one harvest is gathered in April, one about July or August, and a third in November. The first is stated by Crawfurd to afford the best fruit, the second the largest quantity, the third being a sort of supplement to the second.

The ripe fruit is gathered by means of a barb attached to a long stick. The indications of maturity are the blush acquired by the external covering, which at same time splits open and displays the nut in its gorgeous crimson net. The fruit being divested of its pulpy cover, the mace is then removed, and either flattened by the hand in single layers or tied in double blades. The only preparation which the mace undergoes is drying in the sun, or, in rainy weather, by artificial heat; some experience being required to determine the exact point at which the spice is sufficiently desiccated. If over-dried it loses flavour, becomes brittle, and breaks in packing; while, if not

dry enough, it is apt to become mouldy, and, the vitality of the eggs of the insect to which it is subject not having been destroyed, the worms breed, and the spice is rendered unmarketable. The Dutch sprinkle the mace with salt water prior to packing it, as an additional preventive against insects.

The shell of the nutmeg is very hard, and cannot be broken in the fresh state without injury to the nut. For this reason, to secure shrinkage of the nut from the shell, as well as thoroughly to destroy the germs of insect life, the nutmegs are subjected to a long process of desiccation. For the first few days they are exposed to sun heat; after which they are taken to the drying-house and spread on a kind of basket-work stage, at a height of about 10 feet from the ground, and submitted to the action of the heat and smoke of a smouldering fire. The heat must be gentle, not exceeding 140° Fahrenheit, and the nuts are turned every day or two. After from two to three months of this treatment the nuts have shrunk from the shell sufficiently to admit of the latter being cracked by a wooden mallet and thrown away. The next stage is a very important one, consisting of a careful examination of each nut and sorting out those which are shrivelled or worm-eaten. Unless great care is taken with this process, nuts containing the germs of the insect to which the spice is so subject may be left and contaminate the lot. So rapidly does the worm multiply that the whole stock of a warehouse or the cargo of a ship may be infected and entirely lost. After undergoing this process of sorting, technically called *garbling*, the nuts are dipped in a thick mixture of lime and water, again dried in the sun and cleaned off; or by some growers are instead dusted with well-sifted dry lime. This is intended as a final protection against the insect, and the nutmegs are then packed in tight casks or in chests which have been smoked and lime-washed inside.

The true nutmeg in commerce is found in two varieties, the "royal" and the "green." The former is the largest, and its mace is longer than the nut, which in the latter is not entirely enveloped by the mace. The most valuable of the crop are those which are regularly gathered from the trees as they ripen, and are subjected to the several stages of preparation before described. The fallen nuts, which are more or less injured in flavour and appearance by lying on the ground, are sent to inferior markets or crushed for their oil. A good nutmeg should be large, round, and heavy, of a light-grey colour, and strongly marbled in the cross section.

As there are several species of nutmegs, growing wild, which are inferior in those qualities which constitute the true value of the spices, nutmeg and mace, it is not surprising that these are often mixed with the true nutmeg. To the inexperienced eye they are not readily distinguishable, but their insipidity when compared with the fruit of *Myristica fragrans* readily discloses their presence when put to the test of taste. But fraud goes further than in the admixture of inferior species; the true nutmeg before being sent to market being frequently sweated for its essential oil, the orifices created by the boiling being filled up with powdered sassafras. Sweated nutmegs can, however, be detected by their lightness.

There is no necessity to dwell upon the well-known culinary uses of the mace and nutmeg. From both of them, but chiefly from the nut, is obtained, by simple distillation in water, a volatile oil; the maximum yield of this product being only $\frac{1}{32}$ part of the weight of the nut. It is of a pale straw colour, possessing in a concentrated form all the properties of the nutmeg. It is used in medicine both externally and internally as a stimulant. Taken internally it is useful in atonic diarrhœa and in some forms of dyspepsia; and, diluted with a bland oil, is a useful application in rheumatism, paralysis, and sprains. It is soluble in alcohol and ether, has a pungent taste, and a strong nutmeg odour.

Another and larger product is a fatty fixed-oil, known in commerce as *Butter of Nutmegs*. This is obtained by expression; the ordinary yield being about 20 per cent. of the total weight of the nut, although Professor Neumans, by exact experiment, obtained as much as *one-third* of the gross weight. To obtain this product the nutmegs are beaten to a paste, which is then put into bags and steamed, afterwards pressed between two hot metal plates for expression of the oil. The refuse and damaged nuts are chiefly used for this purpose. This product is of the consistence of tallow and of a yellowish colour. It is commonly but erroneously known in the shops as "expressed oil of Mace." Its consistence is firm, and it has a fragrant odour of nutmeg. In commerce it is met with in cakes and also in small earthen pots. "Butter of Nutmegs" is employed as an external application in rheumatism and palsy, and forms an ingredient of pitch-plaster. It has a certain amount of acridity, and if used as a liniment will blister the skin after being rubbed in for some time. A fraudulent imitation of Butter of Nutmegs is made by an admixture of animal fat or spermacetti boiled with powdered nutmegs and flavoured with sassafras. A specimen may, however, be relied on as pure if it dissolve in four times its weight of strong boiling alcohol or half that quantity of ether.

Another species, native of South America, *Myristica sebifera*, produces a very large percentage of fixed oil, which is useful in soap and candle making, but does not possess the fragrance of that from *M. fragrans*.

In their physiological effects, the activity both of nutmegs and mace depends upon the quantity of volatile oil contained. In moderate quantities they produce the carminative and stimulating effect of other spices; but food *highly* seasoned with nutmeg may prove injurious in cerebral affections. In large doses they are narcotic, cause giddiness, delirium, sleepiness, and actual stupor. A case is given by Pereira in which two drachms of powdered nutmeg produced drowsiness, which gradually increased to complete stupor and insensibility. In mild cases of diarrhœa it is a good substitute for opium, and may be taken in hot brandy and water, unless the use of spirit be contra-indicated.

It must not be supposed, says Lindley, that the insipid nutmegs are inert. It is stated that in New Guinea, where these* are common, persons who ate as many only as two were soon after attacked with violent diarrhœa and disturbance of the stomach. A single fruit produced nausea, a sensation of fullness, and wind.

Actual experiment, says Dr. Royle, has often proved that a plant of commercial value will thrive in a climate not wholly similar to that of its natural habit. So in the case of the Nutmeg, the early efforts of the East India Company to extend its area of production to Sumatra were discouraged by old planters until the success of Mr. Cole, a Civil servant at Bencoolen, when the sceptics were convinced that the spice did not only grow well, but produced in the greatest perfection.

The healthy growth of the true Nutmeg in Northern Queensland affords fair ground for expectation that this valuable tree may prove commercially productive on our warm coast lands. The effect of grafting *M. fragrans* on our native species is worth trying.

* Probably identical with *M. insipida* of Queensland, referred to before.

THE OLIVE.

(*Olea Europœa.*—OLEACEÆ.)

The subject of the Olive is too large to treat satisfactorily in a work of this character, and I have found some difficulty in compressing it into the space available for the purpose. Such of my readers as desire more detailed information can obtain it by reference to the following works, namely:—

"The Olive, its Culture and Products in the South of France and Italy," by William R. Boothby Sheriff of South Australia; published at the Government Printing Office, Adelaide, South Australia.

"Cultivation of the Olive, and Manufacture of its Fruit," by the Hon. Samuel Davenport, Adelaide; published by the Chamber of Manufactures of South Australia.

"The Olive and its Products: A treatise on the habits, cultivation, and propagation of the tree, and upon the manufacture of oil and other products therefrom," by the author of the present work.

The Common Olive is, in its wild state, little more than a shrub, thorny and unattractive in appearance; but, by cultivation, has become a tree varying according to species, at maturity, from twenty to forty feet in height, and though sober of aspect and of peculiar tint, is by no means destitute of beauty. The tree is an evergreen with leaves somewhat leathery in appearance, the upper surface being of a subdued rich green colour peculiar to the Olive, which has given its name to the tint; the under side being minutely scaly and of a whitish-grey. This is said to be observed in a remarkable manner when the lightest breeze is passing through the valleys of olive-gardens, the effect being by one author prettily likened to a silver cloud gliding across the landscape. The leaves are opposite, and, in shape, either oblong or lanceolate, and entire. The small white flowers are in axillary bunches, or in thyrsi at the ends of the twigs, drooping when at maturity. The fruit is a drupe, with a unilocular stone; the pericarp, shell, and kernel each containing, but in different proportions, a fixed oil, the existence of which constitutes the great commercial value of the tree. To the same natural order belong the Lilac, the Ash, and the Privet. The Olive is by some supposed to have been originally a native of Greece, by others of Syria, &c.; but the species is found widely distributed in nearly all the temperate parts of the globe. It will mature its fruit neither in very cold nor very hot climates, although the tree is to be found in both. But, while extremes of temperature are adverse to fruitfulness, the greatest enemy to the Olive-tree is frost; but even this does not inflict material injury unless following immediately upon wet weather. The degree of injury from this cause varies, being influenced to some extent by the age of the tree. Sometimes all the tree above ground is killed, sometimes only branches here and there; but the older the trees, the better able they appear to be to resist the action of cold. The roots, however, are rarely if ever injured by frost; and the damage can therefore be more quickly repaired, by training a new stem from the old root, than if the tree had to be entirely replaced.

In hot climates the effect of heat may be mitigated, and greater fruitfulness attained, by planting on slopes facing the morning sun, so that the extreme heat of the day may be either entirely shaded from the trees or it may fall with softened severity. On the other side of the world the Olive is successfully cultivated, in all parts of Spain and Portugal, which are not too elevated. It extends over France, south of the mountains of the Cevennes; over Italy, south of the Apennines; and Turkey, south of the Hæmus. It is grown on the northern coast of Africa (in Morocco, Algeria, and Egypt), in Hong Kong, and almost throughout the Republic of Chili. The Olive is the great staple of Corfu; and its cultivation is rapidly increasing in the Southern States of America, where it is stated that a fair crop of oil is obtained from trees four years from the nursery, and a full crop from trees eight years planted.

Ancient writers upon the Olive state that the tree will not thrive remote from the influence of the sea-air; and this opinion has been handed down from generation to generation, and is entertained, even at the present day, by men whose authority upon the general subject cannot be lightly regarded. The fact, however, that the Olive forms a staple product throughout Spain, even in those parts which are so remote from the coast as to be quite beyond the influence of the sea-air, seems to set the matter at rest. The idea is probably traditional, and takes its origin in the fact that in the early history of the Olive the countries where it was grown were chiefly maritime. It is still not inconsistent to suppose that sea air is beneficial to the tree; and the practice which obtains among some of the Portuguese oil-growers of using sea-sand in making their plantations may be well worth our attention in considering the suitableness of the Olive for some parts of Queensland. The Olive possesses this great advantage, that it will not perish from neglect—at best, it does not require much labour or care; and, unlike the vine, the mulberry, and other trees, if long neglected, will revive as soon as the ground about it is again stirred and it receives attention, and will respond to the care bestowed upon it by yielding as before. By means of the Olive much land can be utilised which has been hitherto regarded as comparatively valueless; and when we bear in mind the longevity of the tree, its great productiveness, the manifold uses for food, and in various industries to which its products can be put, it is undoubtedly the interest of the colonists of Queensland to test its importance and usefulness. Brisbane is nearly the northern limit of Queensland for the production of the Olive, as it is the southernmost, or very nearly so, for the successful cultivation of the Mango, the Jaca, the Alligator Pear, and other trees.

The Olive possesses one great qualification over almost every other known tree; that is, its permanency—once planted under suitable circumstances, and it is planted *practically for ever*. It attains an almost incredible age, and has been extensively cultivated for an unknown length of time.

One of the chief features of the Olive as a staple product is the increasing and enduring character of the yield. With the commonest care and intelligence, the returns are sure and progressive. Nor need the farmer be deterred by the not unnatural dread of plunging into a new industry, the fruits of which cannot (like the favorite corn and hay crops) become available for turning into cash in a few months. Let those who do not care to expend what is necessary for the establishment of a plantation, plant Olive trees on the boundaries of their cultivation paddocks, just inside the fences. By this means, they occupy no ground available for more immediately profitable crops; and, while putting in a few score of trees in this way, farmers may try the experiment without risk of loss. When they discover that they are able to manufacture oil enough for the many uses to which it can be put on a farm, and for family consumption, they will require no persuasion to plant on a large scale, and will regret the half-heartedness which prevented their doing the same thing years before.

The Olive can be grown and sold for crushing, or be crushed on shares. Unlike sugar-cane, the crop is compact and portable; and with common precautions, can be kept without deterioration for a considerable time after gathering—the great advantage of this last-mentioned qualification being that the farmer, after harvesting his crop, could cart it to the mill and convert it into money or money's worth at his leisure.

The popular belief that the Olive is a slow-growing tree, and that it takes many years to come into bearing, must be considerably modified by facts deducible from the experience of modern growers. By careful selection of variety to suit climatic and other considerations, and with intelligent

cultivation, the Olive has proved itself to begin to be productive as early as the orange, although it takes a few more years than the orange before reaching the limit of productiveness. There need be no discouragement to the grower from the slowness with which his Olive trees arrive at maturity, unless he plants indiscriminately as to variety, and does not pay reasonable attention to aspect, character of soil, and other considerations, which would be allowed to have their full effect in the planting of bananas, peaches, and other fruits of ephemeral value.

There are many varieties of the Olive, differing in the size attained by the tree or by the fruit, period of ripening, quality of oil, capability of resisting frost, etc. Baron Mueller, in his " Select Extra-Tropical Plants," gives a list of 34; and some of these, as well as others, are quoted and carefully described by Messrs. Boothby and Davenport.

The Verdale, Colliasse, Clermontais, and Gros Cornialle, appear to possess the advantage that they never grow large, and thus their fruit is easily gathered. They may be planted 16 feet apart, instead of the traditional 40 feet; an immense advantage, as thus each acre of land may grow many more trees. The Verdale is specially recommended, as bearing fruit in the third year.

The fact that there is a great difference in the period at which different varieties of the Olive come into bearing is beyond doubt. This appears to have been clearly proved in South Australia; where, among some valuable seedlings raised, some have proved much earlier bearers than others.

I think that in our early operations we shall do well to plant those kinds which have been proved by the nearest of our neighbours * who have grown the Olive to be early and abundant bearers. After that, we may with great advantage avail of the experiences of South Australia; although with further experience we shall probably, sooner or later, select some other kinds as better adapted to our warmer climate. This will probably be a locally raised seedling from locally grown fruit.

As the Olive will thrive and be most prolific in dry, calcareous, schistous, sandy, or rocky situations, it is obvious that, by its means, much land at present regarded as valueless for agriculture, and comparatively so for horticulture, may be utilised, under proper conditions of climate, for the production of a staple of commerce certain in its annual return, and for which there is an unfailing market.

In comparing the suitability of various soils for the Olive, I must not be supposed to advocate absolute poverty as a desirable qualification. There are few examples of plant life for which a certain degree of fertility is not necessary; and in the case of the Olive, if the soil is too poor, it must be enriched artificially. It is, however, found that any good vine soil is also good Olive soil.

In recommending dry soils, I have of course implied that they must be well drained. The Olive will not thrive in ill-drained situations; and nothing but disappointment can result from disregarding this condition. Nor does it like clays, even if drained. For successful cultivation the soil must be loose and permeable; and, as a general rule, the deeper the better.

Although excess of moisture is one of the enemies of the Olive-tree, a certain amount of moisture is very necessary to maintain the health of the tree and for the formation and maturing of the fruit; and this affords the

* Camden Park, the estate of the late Sir Wm. Macarthur, in the county of Cumberland, N. S. Wales, is the nearest locality to Brisbane where the Olive has been grown to an extent sufficient for the manufacture of oil, and for testing different varieties of the tree.

principal reason why deep cultivation is desirable when it can be obtained. Where, however, this is impracticable, mulching the surface of the soil, and occasional waterings (especially during the first two or three years) in very dry weather should be resorted to.

The sunny slopes of hills are stated, by authorities on the other side of the world, to be best suited to the natural habit of the tree; but, for the reason which I have before given, in Queensland it is the morning rays which should be courted, and not the fiercer ones of noon. Eastern slopes possess the additional advantage of protection from the westerly winds of winter, which though not too cold, are sometimes very boisterous.

The great facility with which the Olive tree can be propagated is not the least of its good qualifications. In fact you may choose, among almost every conceivable method by which plants are increased, the way that takes your fancy or suits your requirements best. In planting cuttings in a nursery, if the soil is not naturally sandy, some sand may, with advantage, be put along the spade cut as the cuttings are put in. They need not be more than from eight to twelve inches long, should be neatly trimmed with a sharp knife so as not to bruise the bark, and only one good bud be left above the ground. The cuttings may be either from the branches or roots. Root cuttings are best planted entirely under ground; but there is no special advantage in taking cuttings from the root, and the practice is not advised unless you are removing or thinning out your trees, or are at a loss for material from which to raise a large nursery stock of any particular variety. Of course a tree reproducing itself so readily from cuttings will grow from layers.

Suckers, which often rise from the roots of old trees, if strong, and carefully and neatly detached with a heel, make good trees, as they afford a well-formed stem to begin with.

Seedlings can be raised by tens of thousands in a light and well-drained soil; but, before being sown, require to be subjected to some preparatory process which will decompose the oily pericarp and allow the moisture to get to the kernel. To accomplish this, the seed may be steeped for twelve hours in hot water or yeast, or immersed in an alkali which, by combining with the oil, converts it into soap which is readily soluble in the moist earth.

The seeds used should be the *finest fruit* from the *healthiest trees*, and should be sown as soon as ripe. The object of raising seedling plants is two-fold; the primary one being to obtain stocks on which to graft. A second one, and of great importance in a climate like that of Queensland, which is not so well assured for the cultivation of the Olive as many other parts of the world, is the chance which it affords of obtaining new varieties suited to the climate. For this purpose it will be desirable to use seed the produce of trees grown in the colony; and a piece of ground should be set apart for the purpose of testing the seedlings, which must be selected from the strongest and healthiest plants in the nursery beds.

This experimental ground should be deeply worked, well drained, and generously treated.

Grafting the Olive is much practised, and is among the most certain methods of securing strong trees of approved varieties. The "Shield," "Cleft," and "Crown" grafts are all used and variously recommended; but it is immaterial which method is adopted if the scion and stock suit each other in point of age and size. Underground grafting in this climate is decidedly preferable, not more than two eyes of the scion being left above ground. The operation should be performed in spring when the sap is rising, the scions being of two-year-old wood.

Truncheons are very stout cuttings, varying in length from one foot to ten feet, and in diameter from one and a-half to six inches, according to the method adopted in planting them. Truncheons are planted in two ways, each having its advocates. Under one method the pieces might with more propriety be called "poles," as they reach the length of eight and ten feet. But while the advocates of this method give the range of length from four up to ten feet, they have a corresponding difference in the depth to which they open the holes to receive them, which ranges from twenty inches to four feet. It is probable, therefore, that where the soil is deep and well drained it is found preferable to plant deep; and then, in order to have sufficient height above ground to form a good stem, a longer piece is required to start with. Keeping then the above considerations in mind, the process is as follows:—In early spring open the holes to such depth within the above limits as the nature of the soil admits. Next plant the truncheon or pole upright, taking care to throw in a good layer of chopped turves and leaves, decayed stable manure, or any fertilising matter which has thoroughly ripened and is not hot, and filling in *firmly* with the soil which was taken out of the hole. Leave the ground round each plant slightly hollowed to facilitate watering, which, unless the ground is in a moist state, should be done at once, and repeated from time to time when the weather is dry. The object of enriching the bottom of the hole is twofold. It stimulates the truncheon to send out roots from the bottom end, and so ensures a well and deep-rooted tree; while it also assists mechanically in retaining moisture where it is most needed.

In transplanting rooted trees from the nursery, or to relieve too thickly planted rows, the same precautions should be adopted.

When the wood left above ground is long, the soil is sometimes heaped round it in the form of a cone, to mitigate the drying influence of the air before the plant has rooted, a hole, which is kept open by a wisp of straw, being made on one side to facilitate watering in dry weather.

The advantage of planting truncheons in the way described (in the position which the tree is to occupy permanently), is that you thereby save a whole year, and commence with a good stem to form the trunk of the future tree; but I need hardly say that there must be no scamping of labour or slurring of the work, which to effect these objects with certainty must be thoroughly and intelligently done.

I come now to the second method of propagating by truncheons. In this case they are cut from *one* foot to *three* feet long, the short lengths being, I am disposed to think, preferable. They should be cut neatly, without any bruises or ragged edges in which moisture could lodge and do mischief; and bedded *horizontally* four or five inches beneath the surface. The soil for this purpose should be fine, and be kept moderately moist. The grower must not be impatient if the shoots are long in making their appearance, as much depends upon the season. In two years, however, you will have trees four to six feet high, with stems from one to two inches in diameter, according to kind, which are fit for planting out, and from which you will be able to take strong scions for grafting your seedling plants. These, of course, you have been growing in the meanwhile, if you want any considerable stock of trees. Keeping carefully in mind the heat of our climate and the dryness of our spring, I would recommend this method of burying truncheons in preference to the other for beginners in this important industry. The other method, with some additional protection to the exposed stem from the trying influence of the air, may answer as well in Queensland as elsewhere.

Propagation by Uovoli.—This method of increasing good varieties of the Olive is both curious and interesting. The word is Italian, and means literally "little eggs." These are small knots or excrescences which form, often in some numbers, on the bark, especially of the upper roots. They are easily detached with a sharp penknife ; but care must be taken not to injure the tree. This should be at least ten years old, both because before that age it is not worth while examining for *uovoli,* and because the tree should be mature, deep-rooted, and strong before such liberties are taken with its bark. When removed they are planted like bulbs ; and, by much the same process of nature as in the case of the propagation of the vine and the potato by eyes, in due course become young trees. These *uovoli* are, in fact, embryo buds, or what are technically known as *knaurs,* the theory of which is that they have been adventitious buds, which, by pressure of the surrounding growth of bark, have been forced into woody excrescences.

Cultivation.—The importance of thorough drainage for the Olive has been already pointed out ; and the intending cultivator, bearing this well in mind, will, of course, understand that the digging of holes is not to imply that the intervals are not to be left without being broken up. Where a depth of four feet is used it would be impossible, without artificial drainage, to prevent the wet from hanging about the roots of the trees, unless the soil were naturally deep and very porous. It must be remembered that one of my objects in urging the cultivation of the Olive is, that thereby the slopes of our hills, the soil of which is unsuited for general cultivation, may be utilised. In these situations any considerable depth of soil will not often be found ; and twenty-four inches will, as a rule, be the maximum depth attainable. If this be the case, holes will have no advantage in point of economy over continuous trenching, say to the width of eight to ten feet ; with the additional facilities for drainage, afforded by the latter mode of preparing the ground, thrown into the balance. While such trenches will afford sufficient room for the health of the trees, these will still benefit by the breaking up, at some subsequent period, of the intervening spaces, either by the hoe or plough.

Cultivation between the trees should be practised with caution. There is no mistake so great as to suppose that you are exercising economy by taking out crops from between the trees, unless you are quite certain that the latter are not being robbed of light, air, or nutriment. When the trees are quite young and cover little space, a shallow rooting crop may with safety be taken off, provided that even then the seed is not allowed to fall within five feet each way of the trees. If this be done for a year or two with safety, it is as much as can be ventured ; after which any crop raised, in place of being taken off, should be ploughed in, to restore what the previous crops have taken out of the soil. It is quite possible, however, that the soil, in situations such as those which I advocate for the Olive, may not be sufficiently good to make it worth while to attempt a green crop. In that case, rather than *waste* the space which is not wanted by the trees in their young state, the farmer might advantageously grow pumpkins in holes specially manured, and feed them to pigs ; always remembering also that the worst of our gravel ridges, when first broken up, will give at least one crop of sweet potatoes. While, however, careful cultivation within certain limits between the trees may be permitted, not only must any crop be kept well away from the trees, but the soil about them must be periodically stirred as deeply as is compatible with safety to their roots.

Manuring with suitable fertilising substances, at intervals, forms an important element in the successful cultivation of the Olive, especially in soils naturally poor. While the tree rejoices in the mechanical looseness of

sandy, gravelly, and stony soils, and in freedom from stagnant moisture, the Olive is not among the very small number of fruit-bearing trees which are most fruitful in sterile soil. Nutriment is necessary to its productiveness, and, if not already in the soil, must be introduced artificially. But manure also acts mechanically in retaining moisture, and thus helping the tree to withstand drought, and effecting a saving of labour in watering, which, if the manure has been well dug in, may be done less frequently. The stronger kinds of manures are recommended for the Olive, such as pigeon and sheep dung; but the best of all for sandy soils is night-soil. Raw, unripened, hot manures of any kind are as bad for this tree as they are for most others. There is nothing to equal a good old compost heap; and where the materials are procurable, it will well repay the labour and first cost to make one. This is best effected by excavating a hole of sufficient dimensions, into which should be thrown sheep and fowl dung, stable manure, soot, ashes, refuse fat, scraps of leather, old rags of all kinds, hoofs, urine, leaves and weeds, and other substances which will ferment and rot. The heap should be occasionally turned until thoroughly incorporated, and when mature, which will probably not be for twelve months, may with great advantage be applied to the trees, being well turned in under the surface.

An addition of lime to the compost heap, or its separate application, will soon make its effects visible in the healthy appearance and more vigorous growth of the trees.

Where the soil is absolutely poor, the trees should be manured every year; but, otherwise, every second year will be sufficient. Of course, if the orchard has been established in rich alluvial bottoms, or fat loam, and the trees have a tendency to over-luxuriance, manuring, I need hardly say, is not only not wanted, but would be wasteful, and inimical to productiveness.

Mulching the trees, especially while young, will be found a useful adjunct to the cultivation of the Olive in our hot dry climate. Its effect is principally mechanical in retaining moisture and in keeping the surface of the soil cool. Long manure—grass, straw, or any such substance—will answer the purpose; but it is as well to select something which will gradually decay, and when dug in will act as a fertilizer. Care should, however, be taken that the material selected be free from seeds, or it will involve additional labour with the hoe.

Pruning judiciously is of great importance, as the Olive has the character of only bearing every other year. The fruit is produced on the young shoots of the preceding year; and, in pruning, the object to attain is to secure a regular distribution of wood of the previous year from the axils of the leaves. In poor soil, where the trees would have a struggle to produce both fruit and young shoots for next year's harvest, pruning is especially necessary; and I am disposed to think that, in our genial climate, plantations skilfully managed ought to bear, with fair certainty, a regular annual crop. Some authorities consider that pruning once in three years is sufficient; but this phase of the cultivation of the Olive in Queensland will be better understood after a few years' experience of the effects of the climate. By the old method of leaving the tree to attain its full growth, any considerable crop was not obtained for many years; and hence the character of the Olive for tardy productiveness. Under the present system, however, of cultivating comparatively dwarf trees, abundant crops are afforded in three or four years. A clear, straight stem of five or six feet should be kept. Not only is the growth thus made handsomer, but the tree is more vigorous and strong to resist wind, and the fruit is sufficiently remote from reflected heat, and consequent premature ripening.

The *distance apart* for planting the trees must be determined partly by variety and partly by soil and aspect. Of late years, the propagation of new and highly productive varieties, and the adoption of a system of pruning the trees to such limits as will render the gathering of the fruit, by hand, comparatively easy, has enabled cultivators to bring their trees closer together, and thus to economise space and consolidate their operations. Orchards are now planted at distances from sixteen feet up to a maximum of thirty feet, according to variety; the distance being further regulated by the quality of the soil.

The following Tables will show the number of trees which can be grown per acre at 16, 20, 30, and 40 feet apart respectively. From these tables will be seen exactly the area of land which is saved by allowing no more room to each variety than is absolutely necessary for the healthy development of the trees:—

1.—*Acre, of shape* 220 *feet long by* 198 *feet wide.*

Deducting dray road (12 feet wide), we have—

Area to be planted = 174 feet wide by 196 long,

which will admit of 10 rows, with 11 trees in each row, 16 feet apart,
„ „ 8 „ 9 „ „ 20 „
„ „ 5 „ 6 „ „ 30 „
„ „ 4 „ 4 „ „ 40 „
the fractional parts of the spaces being adjacent in each case to the dray road.

2.—*Acre, of shape* 264 *feet long by* 165 *feet wide.*

Deducting dray road (12 feet wide), we have—

Area to be planted = 141 feet wide by 240 feet long,

which will admit of 8 rows, with 14 trees in each row, 16 feet apart,
„ „ 6 „ 11 „ „ 20 „
„ „ 4 „ 7 „ „ 30 „
„ „ 3 „ 5 „ „ 40 „
the fractional parts of the spaces being adjacent in each case to the dray road.

3.—*Acre, of shape* 330 *feet long by* 132 *feet wide.*

Deducting dray road (12 feet wide), we have—

Area to be planted = 108 feet wide by 306 feet long.

which will admit of 6 rows, with 18 trees in each row, 16 feet apart,
„ „ 4 „ 14 „ „ 20 „
„ „ 3 „ 9 „ „ 30 „
„ „ 2 „ 7 „ „ 40 „
the fractional parts of the spaces being in each case adjacent to the dray road.

Collecting the above results, we have the following table:—

Distance apart.	Acre, 220 x 198.	Acre, 264 x 165.	Acre, 330 x 132.
16 feet	110 trees required	112 trees required	108 trees required
20 „	72 „ „	66 „ „	56 „ „
30 „	30 „ „	28 „ „	27 „ „
40 „	16 „ „	15 „ „	14 „ „

We may form a second table by excluding all consideration of the fractional spaces adjacent to the dray-road, and simply calculating how many times the area required for each tree is contained in the available areas of acres of each of the preceding forms. A table so calculated is as follows:—

Acre of form.	Available area in square feet.	Trees 16 feet apart.	Trees 20 feet apart.	Trees 30 feet apart.	Trees 40 feet apart.
feet. feet.		Trees required.	Trees required.	Trees required.	Trees required.
220 x 198 ...	34,104	133	85	38	21
264 x 165 ...	33,840	132	85	37	21
330 x 122 ...	33,048	129	83	37	21

The method most effective to the eye and for free circulation of air is what is known as "quincunx" form. By intelligent study of the habits of the Olive and careful attention to its requirements, there is no valid reason why, in four or five years from planting, it should not begin to repay the expense of culture; without taking into account what, in the meantime, may have been got off the ground by intercultivation. A year or two before that even, the few olives which may be gathered off each tree may, in the aggregate, suffice to make oil enough for the family requirements; while from the sixth year onwards, it may be relied on in ordinary years as a sure and increasing source of wealth to the farmer.

The shape of the fruit varies according to kind. It is generally egg-shaped, sometimes round, sometimes like an inverted egg, occasionally tapering to a point. It varies still more in colour than in form, according to kind and to stage of maturity. Thus olives may be seen green, whitish, violet, yellow, red, or even black. The fruit is produced in vast profusion, so that an old olive tree becomes very valuable to its owner.

The proper time for gathering is the eve of maturity. If delayed too long, and the fruit becomes over-ripe—especially if it be allowed to fall—you lose in quality though gaining somewhat in quantity. I would point out, as one of the advantages of the crop, that if, from press of other operations on the farm, the owner is unable to gather his olives when he would wish, they are yet available to him—even in a state which in other fruits would be regarded as rottenness—for the production of a still marketable though not so valuable a commodity. Early gathering relieves the tree and gives time to strengthen for another crop. I have already said that the Olive, if left to itself, will only bear once in two years; but there is no doubt that in skilfully managed plantations the trees do bear annual crops, and that the early gathering of the fruit contributes largely to this end.

The best mode of gathering is by hand; the system of cultivating low-growing trees much facilitating the harvest. The gathering can be done by children, and with the aid of light steps the fruit can be reached from the top of the tree. The system of beating the fruit from the tree with light rods of wood should never be practised by the intelligent and painstaking agriculturist. However skilfully done, it cannot fail more or less to injure the young branches, as the blows must fall at random; and what will suffice to bring down the fruit will also strew the ground with leaves and tender shoots. The practice has the additional disadvantage of involving the picking over of the fruit, in order before pressing to separate leaves, sticks, and other rubbish.

Shaking the tree is also resorted to as a means of obtaining the fruit; but, though not so injurious as the beating, is not recommended.

A good method of ascertaining if the fruit is fit for gathering is to apply a slight pressure with the finger and thumb ; when, if oil exudes, the Olives are considered fit for the press.

The largest fruit is the Spanish; and the olives of Andalusia surpass, both in size and quality, those of other Spanish provinces.

The harvest extends over six weeks or two months; and as the fruit matures and is gathered it should be laid on shelves so as slightly to dry. Contact will do no harm so long as it does not bring about actual heating; as excessive fermentation results in inferiority of quality of oil.

The bark, the wood, and the fruit of the Olive are all utilised. The bark is bitter and astringent; and both bark and leaves contain a febrifuge principle called "olivile," and have been used in medicine, the former having been employed as a substitute for cinchona. From old stems a gum resin exudes, with an odour like that of vanilla, and is largely used in Italy in the preparation of perfumes. The wood is one of the hardest and heaviest known, weighing nearly 70 lbs. to the cubic foot: and, as in the case of the "box," has the pith nearly obliterated. It burns well even when green, being highly resinous, and gives out great heat. When seasoned it takes a fine polish; and, being beautifully veined and spotted, and possessing an agreeable smell, is very valuable for turning and cabinet work. It is, moreover, not subject to crack or to be destroyed by insect life. The root wood has a great variety of shades, and is much in requisition for turners' work.

The fruit, in a whole state, is used in large quanties, before coming to maturity, for pickles ; and, to a small extent, also in a dried state. The form in which we are chiefly accustomed to see olives is in small bottles in salt and water. They undergo various treatment to prepare them for this purpose; but while the receipts are numerous, the object and tendency of the various processes is much alike. From many receipts I select the following :—

The lye is to be made as follows :—Take three pounds of fresh wood-ashes, six ounces of fresh quicklime, six quarts of cold water—mix well, and boil gently for thirty minutes, keeping well stirred. When the Olive is full grown, but quite green, gather carefully the quantity wanted, without bruising (ot the largest kind), and place them in a clean vessel (not iron) pure from any greasy matter, and, when the lye is cooled down to 150° Fahrenheit, pour sufficient on the olives to well cover them ; soak for about thirty hours. Then pour off the lye entirely (covering the vessel to prevent the berries running out) and rinse the berries with fresh cold water, and for three days keep them in cold water, changing the water two or three times each day ; then, having prepared the pickle (salt and water) of about the strength that will float an egg (the better plan is to boil the water and pour it on the salt, leaving it till quite cold), and having clean bottles thoroughly dried, put in the berries, carefully selecting them of equal sizes for each bottle, shaking but not pressing them down, and pour in sufficient pickle to cover the olives, leaving a space in each of about an inch from the cork, which should be good and well fitting. Cover with pieces of bladder, well tied on and secured from the air with some wax of black rosin and beeswax.

In this form the Olive is frequently made the subject of adulteration, in order to maintain for the fruit a vivid green colour ; and thus, by making it look nicer, to render it more marketable. Copper is the medium used for this purpose; and the French olives are the most extensively adulterated. In purchasing olives in bottle, select those of a fawn colour, and take care, in order to ensure this, that the bottle is of colourless glass. The Spanish olives are, as a rule, the most free from contamination.

The principal use of the Olive is the production of the olive oils of commerce.

The finer qualities and those freest from rancidity, are most in requisition for food purposes; and, when pure, olive oil is wholesome and nutritious.

In old olive-growing countries, and especially in the South of Europe, the oil is employed for many of the purposes of cream and butter. In Queensland we require no substitute for butter, which is plentiful and good; but the uses of olive oil in cooking are so manifold that its production by ourselves could not fail to be accompanied by increase of comfort and greater economy of living.

A great wool-producing country like Queensland, however, will find another very important use to which to put olive oil. I refer to its application in the manufacture of cloth; from four to five gallons of oil (of some kind) being used in the conversion of every bale of wool.

Scft Soap is the result of a combination of olive oil and potash; and Castile soap, of this oil and soda.

The Marc, or oil cake, is valuable as feed for cattle; or, in a country like this, where stall feeding is not resorted to, it could be put to its other uses of manure or fuel. For the former of these uses it is stimulating, but not lasting in its effects.

The manifold uses of olive oil as a lubricator, and as an external application in surgery, are so well known as to make their mention hardly necessary.

There are other products of the Olive, such as "Oleine" or "Elaine," "Stearine," "Palmitine," and "Margarine," each capable of separation by chemical process, and having their respective uses in the arts and manufactures.

The plant required in the manufacture of olive oil consists of a mill for crushing, a press for separating the oil from the solid portions of the fruit, receivers into which the oil is run from the press, and the necessary vessels for storage and for the market. Besides these, there must be a building of some kind in which the various operations are carried on. In the large majority of cases the machinery employed is of the rudest kind, the same form having been handed down from generation to generation. A verv small capital is required for oil making; and the implements are so simple that, with the exception of the millstones, any intelligent rough carpenter could make them. The labour required being proportionately small, the whole expense of producing oil such as will command a fair price in the market is comparatively trifling. Care and intelligence are, of course, indispensable in this as in other products which have to compete for public favour.

The mills on oil farms generally are very simple, and illustration of their forms are given in my separate work on the Olive. The stones must be of a hard and unabsorbent description, such as granite. The reason for this is obvious, for it can readily be seen that, were the stones of a porous character, they would soon become saturated with oil, which, becoming rancid, would taint all that it came in contact with.

But, while the majority of mills are of this description, there are to be seen here and there machinery of a more complicated and expensive character. In these cases steam or hydraulic power is not infrequently used. In Spain the crushing is sometimes performed by conical iron rollers moved round on an oil-proof floor, on two little margins to prevent the stone being crushed.

There are also to be seen, but very rarely, steam mills; but the crushing is generally done by the Spaniards in the old traditional stone mills. As they usually keep their olives till in a state of putrefaction before crushing them, aiming more at quantity than quality, the inferior appliances, being less costly, answer their purpose better.

They are, however, beginning to awake to the higher profit to be obtained from manufacturing a superior article; and a few more enlightened among the growers, finding the injurious effect of fermentation upon the market quality of the article, extract at an earlier stage, and use the more rapid and effectual means of the hydraulic press.

Screw presses of simple construction are generally used; but the pressure is sometimes obtained by means of lever, or, more rarely still, hydraulic power.

The bags used for enclosing the crushed olives before putting into the press are made of coarse linen, horse-hair, open felt, rushes, or grass; and, when filled, are laid one over the other in the press to the number sometimes of a dozen.

In the extraction of the oil there are two distinct processes, viz.—(1) Crushing, and (2) Pressing.

In the first process the fruit is by some completely crushed, and by others the pericarp only is first crushed, and when the oil from that part of the fruit has been separately expressed the more complete crushing is applied for obtaining the remainder of the oil. By some it is held that the most delicate oil is contained in the pericarp, but there is reason to suppose that much of the finest oil that comes to market is manufactured without any such distinction being recognised.

There is no doubt that much of the delicacy of flavour which characterises the oils of highest repute is due to the pressing and storing rather than to the crushing, while it is also influenced to no slight extent by the variety of the Olive and the degree of maturity and the condition of the fruit when crushed.

The time for gathering the fruit is the *eve* of maturity. It is overripe for the finer quality of oil, if allowed to fall. This condition being complied with, much still depends upon the length of time allowed to elapse between the gathering and crushing, and the treatment to which the fruit is subjected in the interval. There is no doubt that fermentation in the fruit should be carefully watched, as anything like excess impairs the quality of the oil produced. On the other hand, no amount of fermentation affects the quantity of oil; and where this is the main object of the maker, the olives are often allowed to ferment in heaps for months, till it is convenient to crush them, when they have to be dug out of the bins to put through the mill.

But a *slight* degree of fermentation, if unaccompanied by any material heating, does not appear to affect injuriously the quality of the oil, while it facilitates the separation of the oil from the mucilage.

By far the safer plan for the beginner in the industry will be to gather his olives at the right time, and to crush them as soon as he has enough together. In the meanwhile, they should be stored on shelves in moderate layers; the most complete arrangement being one which will admit of a free current of air above and below the layers.

The crushing process should be conducted by a slow and regular movement, without jerking, in order that all the oil cellules shall be broken, and the press not be called upon to do any of the work which is supposed to have been previously done by the mill. The pulp or paste is then shovelled into the bags before described, which are placed one on the other to a conve-

nient depth in the press. In this process, as in that of the crushing, the power should be applied steadily, slowly, and regularly, to afford time for the oil, as it exudes, to escape from the press through the proper channels. The pressing should be conducted u nder a warm temperature, and with as little exposure to the air as possible.

What is generally known as "virgin" oil is that which spontaneously separates, or is obtained by the first pressing, before the application of water or heat to the pulp. This is run into water, where it is allowed time to deposit its mucilage, and, after being skimmed off, is kept separate for the finer uses, or for the more exacting market.

When of good quality, and especially when fresh, olive oil is of a pale greenish colour, with a sweetish nutty flavour much esteemed by those who use it. Inferior oil is of a darker colour, being a yellowish or brownish green; and, even when not sufficiently inferior to be rancid and unmarketable for food purposes, is quite wanting in the peculiar flavour referred to. This fruity flavour depends much upon the quality and condition of the olives when pressed; while by some it is held to be affected also by the variety.

The large and increasing demand for the best qualities, and the consequent high price, leads to adulteration with Poppy, Sesame, Rape, Ground-nut, and Cocoanut oils. Such adulterations may, however, be easily detected by the fact of these oils not congealing at the same temperature as olive oil, which when pure may be completely solidified by freezing. The adulterating oils also retain air, when shaken up, more readily than pure olive oil. There are other tests of a more exact character used by chemists, which, however, need not here be enlarged upon.

Olive oil is sometimes contaminated with lead, because the fruit is submitted to the action of the press between leaden plates, and is sometimes left to subside in leaden cisterns. The presence of lead is detected by shaking, in a stopped vial, one part of suspected oil with two parts of water impregnated with sulphuretted hydrogen. This agent will render the oil of a dark-brown or black colour if any metal deleterious to health is present.

It is significant that where the oil has a high reputation, in the majority of cases the cultivation and manufacture are conducted with unusual care and intelligence. Nor does it appear that the costliness of the appliances has much, if anything, to do with the quality of the produce; for (coming very much nearer home than Europe) I find that in Western Australia excellent oil is made, principally by Spanish monks, who adopt precisely the same course of treatment as is described by Dr. Wm. Thomson, in "The Land and the Book," as in vogue for ages among the Arabs.

So soon as all exudation of oil from the first pressing ceases, the screw is reversed and the bags removed and emptied. The pressed pulp being put carefully aside and the bags refilled, pressure is again applied, and the process repeated until the whole crushing has gone through the mill.

The Marc, which has thus been once pressed, is then thoroughly separated and stirred up with boiling water, and the process of pressing renewed; this time the pressure being increased, though still gradual and steady. This second oil is nearly as good as the first, but apt to become rancid in time. The principal of the oil after this second process is skimmed off the water in the receivers; but entire separation takes a long time, and when it is complete the process is reversed by the water being drawn off from below.

Once more is the Marc subjected to treatment with boiling water, and it is at this stage that, when the stones were not crushed in the first milling, that process is now gone through, and the last of the oil obtained. This pressing is, however, regarded as of inferior quality, and is kept carefully separate from the results of numbers one and two.

The water which has been used in the several processes, and which still contains an admixture of oil, is conducted into large reservoirs, generally constructed underground. Here it is left for a considerable period, during which the mucilage, water, and oil thoroughly separate—the former falling to the bottom, while the latter rises to the top, whence it is ultimately skimmed off, and applied to local uses of an inferior character—such as burning in lamps.

There are yet processes for still further extraction of oil to the last fraction which it is unnecessary here to describe. My object is to encourage the establishment of oil-making as a new industry; and to show that some of the processes are simple yet perfectly efficacious, and require so little money that the application of such a large word as capital would be out of place.

After manufacture the oil is finally deposited in stone jars or in tanks, to facilitate the deposit of impurities which are still held in suspension. Air and light are both excluded, as they would tend to decomposition and rancidity. In a few months the clear oil is racked off into fresh jars for stock, or into other packages for the market; while the inferior is sold for soap-making, lighting, lubricating, or other such purposes.

The ultimate quality of the oil depends much on the nature of the places selected for its storage. Gallipoli, which is one of the greatest oil depôts of the world, owes this advantage to the fact that it is built on rock of such quality as to furnish, at the labour only of excavation, admirable chambers for the reception of oil, which there clarifies sooner and keeps sweet longer than in any other place. The oil which in its turbid state arrives at these depôts black and utterly unfit for market, in time becomes bright and yellow without any help from man. Great care is taken to keep the several qualities or stages distinct.

The oil in its crude state contains impurities of various kinds, albuminous, mucilaginous, and other; and to render it clear and fit for its various uses, and consequently marketable, various methods are used. Simple settlement appears to be the process, if it can be so called, most in vogue; but hot air or steam, caustic lime and infusion of nut-galls, are resorted to as purifying mediums.

The Arabs produce excellent oil, knowing no other means of clarifying than by settlement in cisterns or jars.

Those of my readers who contemplate the cultivation of the Olive in Queensland may be content with keeping in view for their first manufacture, purification by simple settlement; because, however effectual any of these other processes may be, this method is found sufficient for a vast quantity of the best olive oil produced in the world.

Decandolle states the quantity of oil produced by the Olive at fifty per cent. of the gross weight. Sieuve tells us that 100 lbs. of olives yield 32 lbs. of oil, viz.:—21 from the pericarp, 4 from the kernel, and 7 from the shell. Others state it at 25 per cent.; while from an inferior variety the yield is set down as low as 10 per cent.

Calculating the yield per tree, it is extremely difficult to give an average. In the case of the Olive as with many other vegetable products, no rule can be laid down. Its productiveness is governed by variety, climate, soil, culture, and age.

The quantity of the crop is also liable to be affected by extremes of wet or drought, lateness of season, hail-storms, gales of wind, and seasons unusually rife with destructive insects; but after allowing for all possible drawbacks, in Olive countries, the tree is considered to be one of the most profitable crops known to agriculture.

In most of the statements given I find some point of weakness which destroys their value as a guide. Where the average per acre is given the age of the plantation is omitted; while from the produce of single trees in exceptional circumstances little can be learned. The lowest average that I find is 1 gallon per tree; while on other estates the average is given at from $1\frac{1}{4}$ to 2 gallons per tree. The yield of individual trees is given at from 12 to 20 gallons; while one tree of renown is stated to have yielded as much as 55 gallons, and another 3 cwt. of oil.

Taking the lowest average, viz., 1 gallon to the tree, and sixty trees to the acre, the produce at *8s. a gallon, the Brisbane market value of the imported article would be £24 per acre in the early years of bearing; while the value of the Olive when cultivated increases as a matter of certainty with each additional year of age until maturity. But, in the face of this indisputable fact, and the knowledge that a plantation of Olives is a permanent, safe, and improving investment of a most enduring character, we can well afford to be patient for our first returns. Taking the produce in the early years of bearing at one-fourth of that named, with the knowledge of what to expect as year by year the trees grow older, we can still well afford to wait.

I do not desire to import into the calculations of profit the residuum of oil-cake as an important item; but this, of course, also has its value. In Australia we have not been in the habit of stall-feeding cattle; but it is by no means certain that, as population becomes more dense, and our grazing grounds more remote from the cities, it may not yet enter into our agricultural system. Apart from a somewhat wide question like this, there is at least our old friend the pig quite prepared to convert the Olive oil-cake into bacon, hams, and lard.

The Olive has fruited well on coast lands near Brisbane, and gives good promise on the Darling Downs. Of the plantation formed by the late Dr. Ricci on Westbrook, Mr. Davidson, the manager of the station, writes me as follows:—

"These trees, now six years planted, have grown exceedingly well, in height rather than thickness, some of them being quite 10 feet high. This I consider a great growth, when it is allowed that the trees have had to pass through four most severe seasons of drought and one of the worst winters for frost ever remembered here, receiving during all this bad time no artificial watering or help. Some of the trees fruited last year, and a few this. The fruit appears to be of first-class quality, being well fleshed and of good size. I have no doubt, if these trees get a good season or two, they will thrive and bear splendidly. I am of opinion that the tree will do far better if grown on a chocolate soil than on the heavy black."

Mr. Thomas Petrie, writing me about his olive trees, says:—

"I have a few that look very well and bear freely. The fruit has been allowed to drop off the trees, and little heed taken of it. They are about nine or ten years old, but for some years they were left cramped together, and then planted out round a walk in holes, just to fill up some spaces, hoping in time I might be able to give them some attention. The largest are about 20 feet high, and 18 feet across. With ordinary care I think they would thrive well here."

* The market price in Adelaide of the local product is 12s. per gallon.

OTAHEITE GOOSEBERRY.

(*Cicca disticha.*—EUPHORBIACEÆ.)

This is a small tree; the light green feathery foliage, borne on short slender branches, having a pretty effect. It is a native of the East Indies, but has been long naturalised in the West Indies, Mauritius, Java, and elsewhere. I cannot find that it is indigenous to Tahiti; and, unless it be, even though naturalised there, it is difficult to account for its vernacular name, of which no explanation is offered by the authorities.

The fruit is small and nearly round, somewhat flattened, with strongly marked rounded ribs at the sides. When ripe it is of a waxen, white appearance, and greatly enhances the beauty of the tree. The flavour is a strong sorrel-like acid, rendering it unfit for eating raw; but it cooks well. It is also used largely for pickles, and makes an excellent jam not inferior to the English gooseberry. The tree produces two crops of fruit in the year.

The seeds are cathartic, and the root violently purgative. The leaves are reputed to make a good sudorific.

In countries where the Otaheite gooseberry is grown it finds a market for culinary purposes.

It can be propagated either from seed or cuttings.

PARAGUAY TEA; MATÉ.

(*Ilex Paraguayensis.*—AQUIFOLIACEÆ.)

This is the product of a handsome tree, about the size of an orange tree, a native of South America. The leaves are evergreen, bright, and glossy; the flowers are white, growing in clusters; and the fruit takes the form and appearance of the berry of the Christmas holly.

The tree is found growing in the greatest abundance in most of the South American States; and probably derives its specific name from the circumstance that Paraguay used to be the chief "Maté" producing state of the group.

The Yerba (or Herva) Maté is even more used among the people of all classes in the South American States than is tea among ourselves; being not only a concomitant at meals, but even taking the place of the contents of our pocket flask as a stimulant.

In simplicity of preparation from the raw material it has the advantage of ordinary tea. Three qualities find their way to market. The first consists of the early bud of the leaf when only partially developed; the second is the full-grown leaf stripped off; and the third the leaf and small twigs roasted on the branch without any previous preparation or care.

The roasting is done over a slow fire in the rudest manner; and when well scorched, the leaves are reduced to a coarse powder in a rough wooden mill, and the product is ready for use. There is nothing in all this which could not be done in the most humble household.

The infusion is prepared in exactly the same manner as our old and intimate friend of the tea-table. The "teapot" in this case is made out of a kind of gourd or calabash, called "Maté" which has lent its name to the beverage itself. Probably to save the necessity for drinking vessels, or possibly from the habit of community in the use of feeding utensils which prevails among many only half-civilised people, the beverage is consumed by each person present sucking his share from the common teapot through a perforated tube, made of silver, glass, or common material, according to the means of each.

It is commonly drunk pure and unadulterated ; but some people add sugar or milk, or both, while others to the pure decoction add a few drops of lemon juice.

The tea must be used soon after the infusion is made, when it forms an agreeable, refreshing, and stimulating drink. Its effect upon the system varies somewhat according to the individual. It soothes the nerves and produces calm sleep ; and in travel gives renewed vigour to the languid or fatigued. It seems to be unquestionably wholesome, and is diuretic and slightly aperient in its effect upon the system.

An English clergyman, speaking of Paraguay tea, writes as follows :— "For some two or three years I have been a 'Maté' drinker, and am delighted to find myself not alone in my indulgence. Considering the easy communication and frequent intercourse between England and the Argentine Republic, it is a source of wonder that the drink of Paraguay has not long ago been popularised in England. In the Paris Exhibition of 1878 the 'Yerba,' as it is called, was sold ; but judging from an extremely musty and stale specimen which I saw in a friend's hands, was perhaps not calculated to inspire confidence. The tea (or herb rather) will keep in perfectly good condition for a long time, if preserved in a cow-skin bag in which it is sold ; in fact, I have some by me now three years old. The chief difficulty is to make the tea. Although, to quote the advertisements, it is done by 'simply pouring boiling water,' yet this requires to be done very deftly, or else the pipe through which the drink is sucked becomes clogged with dust and twigs, and the cup which does 'not inebriate' fails also to 'cheer.' The process of making, to be successful, is thus performed :—

"Having procured your 'Maté,' which is the small gourd from which the tea is drank, put into it two or three spoonfuls of the 'Yerba' or tea, and then closing the top of the 'Maté' with the hand, turn it upside down, and shake it well. The object of this proceeding is to bring the dust to the top and the twigs to the bottom (when the cup is returned to its normal position). Having shaken it thus, turn the gourd round till the 'Yerba' has fallen back just enough to enable you to remove your hand from the orifice without spilling the contents. Then take the 'Bombilla,' a silver tube with a pierced bulb at the end, and slip the same carefully under the 'Yerba' and turn the 'Maté' upright, being very careful not to shake the contents. Then 'pour the boiling water,' adding sugar if desired, and the drink is ready when it has stood (say) one minute. Each charge will bear watering perhaps three times, after which it should be cleaned out.

"I fear that some Europeans will be inclined to object to the process of drinking, which is as follows :—The servant, either black or white, always has first suck (in order to clear the tube of dust) ; the 'Maté' is then handed to the party one by one, and all draw in the liquid through the same pipe. But use accustoms one to anything, and I have drunk contentedly from the steaming cup in very mixed and somewhat questionable company ere now upon the prairie, and should be quite ready to 'repeat the dose.' The drink has one great advantage—it is cheap ; if my memory fails me not, it is about 1s. per lb. The 'Maté' and 'Bombilla' cost, say, 10s. I believe, moreover, that it has great 'staying powers.' The Gauchos, in South America, say that if you want to ride 'long and strong,' take a piece of bread and a 'Maté.' A Chileno I once met on board ship said that he went through the famine of the Commune in Paris on 'Maté.' Possibly, like Alexander Selkirk, hungry but unenlightened fellow-sufferers would have quarrelled over his boots ; they allowed him to take his cup in peace."

The bulk of the staple commodity as it reaches the market is derived from the trees found growing in the wild state; but it is also cultivated in the marshy valleys, though to a limited extent only, like most other things which call for labour in South America. There are also some old plantations of considerable area still left as monuments of the industry and enterprise of the Jesuits.

The "Yerba Maté" costs about 5d. a lb. in Rio Janeiro, and 64 lbs. is estimated as a supply for one individual for a whole year.

There are more than one species of *Ilex* possessing similar properties, and the leaves of which are used for tea. Among these, in South America are the *Ilex Martiniana*, and the *Ilex Gongonha* of Brazil. In some of the Southern States of North America, the *Ilex Cassine*, or *Ilex Vomitoria* (the "Yaupon" or "Cassina") is much used, as is also the "New Jersey tea-tree," *Ceanothus Americanus.*

The "Yaupon," known also as the "Emetic Holly," used to be largely used by the Indians of Carolina, who drank it very strong and in copious draughts, at a certain period of the year, in order to purify themselves. It acted as an emetic. So much was it held in esteem that the coast Indians were able to drive a considerable trade in the leaves of this plant with the Western tribes. It is still esteemed in North Carolina as useful in promoting perspiration. *Ilex dahoon*, and *I. myrtifolia*, are reputed to possess similar properties.

Paraguay tea appears to possess all the good qualities of the common tea, with the great additional advantage of simplicity of cultivation and preparation. The plant grows well in Brisbane and all along the Northern coast, and is easily propagated by layers and cuttings. It does not seem to be at all exacting as to soil.

PATCHOULI.

(*Pogostemon patchouli.*—LABIATÆ.)

A small perennial, shrubby, but insignificant looking herb, of no interest whatever in the garden; a native of Silhet, Penang, and the Malayan peninsula. It has broadly egg-shaped stalked leaves from 3 to 4 inches long, with the edges slightly lobed and round-toothed. The small whitish flowers tinged with purple are formed in dense spikes at the ends of the branches and at the axils of the leaves. The leaves are covered, especially on their under surface, with a soft, pallid pubescence, which gives the plant a greyish appearance.

The plant, which is called in India "Puchá-pát," yields, by the distillation of its leaves and young tops, about 2 per cent. of a volatile oil of a yellowish-green colour, from which the essence of Patchouli is prepared. The peculiarly strong and persistent perfume, while disagreeable to some people, is highly prized in Europe, and in India is one of the commonest essences in the bazaars.

The introduction of Patchouli into Europe is accounted for in the following manner:—A few years ago, real Indian shawls bore an extravagant price, and purchasers distinguished them by their odour—in fact, they were perfumed with Patchouli. The French manufacturers had for some time successfully imitated the Indian fabric, but could not impart the odour. At length they discovered the secret, and began to import this plant to perfume articles of their make, and thus palm off homespun shawls as real Indian ones. From this origin the perfumers have brought Patchouli into use.

The wild plant is collected and dried in the sun. Care is taken that the process of drying is not carried too far, or the leaves become brittle and crumble to dust in packing. The dried tops, technically known as *summitates patchouli*, are imported into England in boxes of 110 lbs. each, and in half-boxes. The dried article is said to smell more strongly in dry than in damp places.

In the simple dried form Patchouli is also used to fill *sachets*, and is put in muslin bags with clothing to keep away moths and other destructive vermin. The leaf is also used in India as an ingredient in tobacco for smoking. Upon a larger scale the wealthier natives use the plant for stuffing mattresses and pillows, on the supposition that it is very efficacious in preventing contagion and prolonging life.

The excessive use of the perfume, however, may be attended with ill effects. A French writer, in the *Annuaire de Therapeutique*, cites the case of a young lady who was seized with a passion for Patchouli. Her linen, dresses, and furniture were saturated with it. In a short time she lost her appetite and sleep. Her complexion got pale, and she became subject to nervous attacks. In this connexion Pereira adverts to the singular sensitiveness of some constitutions, the hysterical chiefly, to perfumes. In women especially, headache and innumerable other nervous affections are readily produced by the agreeable odours of flowers and other perfumes; cases even of poisoning are supposed to have occurred from inhaling the emanations from odouriferous plants.

This plant has long been introduced into Queensland. It is easily propagated by cuttings and slips.

THE PAWPAW TREE.

(*Carica papaya.*—PAPAYACEÆ.)

The male and female flowers being borne on separate trees gives the origin to the name "papaya," the tree appearing to be called in tropical America, which—although it is now scattered in all parts of the tropical and intertropical world—is its original habitat, either "papaya" or "mamai," according to the view taken of male or female supremacy. It is a small tree, never exceeding 20 feet in height, of spongy texture, and generally hollow in the middle.

In the male tree the flowers are white, hanging in a cluster at the end of a long footstalk, and their perfume is delicious. The flower is generally followed by small elongated pear-shaped fruit of no value. I have known the female to fruit freely without any male in near proximity, but one male tree at least should certainly be kept in the garden.

In the female tree the flowers are larger, of a bell-shape and yellow colour, with quite a short footstalk, and the fruit clusters close to the tree.

The ripe fruit has the colour and appearance of a rock-melon. It has a somewhat peculiar though insipid flavour, and while not a general favourite is in a very remarkable degree a wholesome fruit. Taken in the cool of the morning, quite ripe and fresh from the tree, and eaten with sugar—and for those who like it a little sherry also—it is not only palatable and pleasant but is a valuable aid to health

For cookery it is applicable in many useful ways. The ripe fruit for pies, fritters, and such purposes, is far before pumpkin. The unripe fruit makes good pickle and preserve, and plain-boiled, after soaking to remove the milky juice, makes a dish quite equal to vegetable marrow.

The milky juice of the unripe fruit is admitted by high medical authority to be an efficient vermifuge; one dose being often sufficient to expel the worms from a child. A similar property is possessed by the seeds, which are by no means unpalatable, tasting exactly like cress.

Experiments have also been made with the juice of the pawpaw in diphtheria at the Academy of Science, Paris. It was applied externally to the diphtheritic deposit, and gives good hope of being a serviceable remedy in that disease.

My lady readers may also be glad to learn that, in an appliance so ready to their hand as the juice of the pawpaw, they have a good cosmetic, which is used for removing freckles; and that in the French West Indian colonies the leaves, which are saponaceous, are used in place of soap for washing the hair.

But the most remarkable thing connected with the Pawpaw-tree is the property, possessed by the milky juice of its unripe fruit, of separating the fibres of flesh, and thus making it tender. Indeed, this property is not confined to the juice of the fruit, but the very exhalations of the tree are said to possess it; and of this fact the Brazilian butchers take advantage to make their toughest meat saleable. This is accomplished by suspending the newly killed meat in the tree, or by wrapping it in the leaves. So powerful is this softening action of the juice that it must be used with caution, or the meat will drop to pieces; an effect of inteneration which makes it even more unpalatable than if left in its original condition of toughness. Some interesting experiments were made in the early part of 1879 upon this subject at the Royal Agricultural Museum, Berlin. A portion of the juice was dissolved in three times its weight of water, and this was placed with fifteen pounds of quite fresh lean beef in one piece in distilled water, and boiled for five minutes. Below the boiling point the meat fell into several pieces, and at the close of the experiment it had separated into coarse shreds. Hard-boiled albumen, digested with a little juice at a temperature of 20 degs. C., could, after twenty-four hours, be easily broken up with a glass rod. The juice can be dried without losing its effect, but its efficacy in this respect does not appear to have been tested over a longer period than six months.

Many authorities repeat the statement that old hogs and poultry fed upon pawpaw become tender; but I can find no verification of this statement, while for various reasons it appears sufficiently doubtful to require the test of actual experiment.

For roasting or baking the best method is to wrap the meat in some of the leaves; and for boiling to add to the water some of the expressed juice or a piece of unripe fruit. It is probable that the exact proportion to be used and the time to be employed to render meat tender, without softening it too much, can only be learned by experience; but in a hot country, where meat is necessarily cooked so soon after killing, a method by which it may with certainty be served tender, without detriment to its flavour or wholesomeness, is worth taking some trouble to determine.

The following extracts are taken from a translation in the *Ceylon Tropical Agriculturist*, of an article on the Pawpaw-tree published in the Padang* *Handelsblad* of February, 1882:—"Native cookery comprises several kinds of tarts, curries, and other dishes prepared from the unripe but not too young fruits of the pawpaw; while, as dessert, the ripe fruit in its turn affords us that relief alleged to be given by vegetable pepsine. The seeds are sometimes taken as a remedy against worms. The effects brought about by the use of the leaves and flowers are confirmatory of whatever has

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* Sumatra.

been written in recommendation of pepsine, for those who have experienced them can bear witness that these leaves and flowers actually possess digestion-promoting properties. Hence the natives make frequent use of dishes prepared from the pawpaw, especially those who consume much animal and heavy food. From the stem as well as the blossoms and unripe fruit of the pawpaw a milky juice may be obtained which, after being exposed a short time to the air, coagulates. Both in a fluid and coagulated state it causes a burning sensation when placed on the skin, followed not infrequently by blisters. Should by ill luck a single drop of it fall into the eye, total blindness is the inevitable result. This fluid has been used with remarkable effect in eradicating corns and warts. The ripe fruit of the pawpaw is a sovereign remedy against dysentery. It is a native remedy, hence probably despised on that account, but the writer has experienced its healing powers. Not very long ago a schoolmaster here laid many parents under deep obligation to him for curing their children suffering from this dreadful disease, and whose recovery the doctor in attendance had despaired of more or less, solely and exclusively by administering to them ripe pawpaw fruit. Whether the doctor profited by the knowledge is doubtful; at least the remedy has not yet been made widely known. A decoction of pawpaw leaves is also a wholesome medicine in obstinate internal fevers. A friend of mine was once fully cured by means of it. That it is an exclusively native remedy may be inferred by the fact that it was prescribed for my friend by his mother-in-law (a native), and that the doctor in attendance stopped his visits on its being administered, on the ground that he would not be a witness to the death of the patient in consequence of the use of this prescription. The root of the pawpaw, rubbed fine and laid as pap on the forehead, has been used with good effect against acute headache."

The tree is easily raised from seed and is a rapid grower, bearing in from 8 to 10 months after sowing. It bears with extraordinary abundance; indeed so closely often are the fruits packed as to interfere greatly with their perfect development. If the fruit is thinned to prevent this, and the flower buds which form above the cluster are pulled off, the remaining fruits materially benefit both in size and flavour—an effect which is much enhanced by copious waterings during dry weather.

In order to secure as many female trees as are wanted, it is best to sow the seed in one or two long rows thinly; and at the first indication of flowering to weed out the surplus male plants. Order in the rows can easily be restored at the first suitable weather. The tree soon passes its prime, and should be renewed by fresh sowings every second or third year.

Another section of the community will be interested in the statement that it is a common practice in Barbadoes to administer an infusion of the raw fruit, or rather a diffusion of the milky juice, in water to horses, with a view, as it is said, of "breaking down the blood;" and it is a fact well established, that, if given to a horse whose blood exhibits the cuffed buffy coat, it will after some time produce a loose coagulum, and reduce the inflammatory symptoms which gave rise to it.

THE PEPPER PLANT.

(*Piper nigrum.*—PIPERACEÆ.)

This is a perennial plant of climbing habit, indigenous to Southern India, Cochin China, etc. It is cultivated in Java, Sumatra, Malacca, and elsewhere in Malaysia, in Cochin China, in Borneo and the French West Indies, and in Southern India. This species of *Piper* is the chief source of the pepper

of commerce, the same plant producing both the "black" and "white" pepper, the difference between the two arising from different methods of preparing the berry. The plant is a handsome climber with shining heart-shaped leaves about the size of ivy, but with very little smell or pungency, the fruit forming on spikes resembling when ripe, both in colour and form, the common currant. Each berry contains a single round seed, which when dried becomes black and more or less shrivelled, presenting the familiar appearance of the "whole pepper" of the shops.

The Pepper is a tropical plant, but is more hardy than some others of the spices, such as the clove and nutmeg, as it will stand exposure in sheltered places even in Southern Queensland. Plants in pots stand the winter well in an open "bush-house" in Brisbane. In Northern Queensland it has grown luxuriantly in some places, but whether under proper treatment it will fruit, and, if so, profitably to the grower, has yet to be proved. Crawford gives the limit of production 5° S. to 12° N. lat., and 96° to 115° E. long., but the fact that the plant will live and grow vigorously on some parts of the Queensland coast affords every encouragement to test its capabilities.

Cultivation.—The pepper plant being a climber requires support. This is accomplished either by using stakes of any rough barked wood, or more commonly by planting trees with suitable bark for the vines to attach themselves to by means of fibrous roots which they emit for the purpose. The trees principally used are the Jackfruit, a species of *Diospyros*, *Morinda citrifolia*, and two species of Coral tree, *Erythrina corallodendron* and *E. Indica.* The pepper luxuriates in a deep well-drained vegetable soil, but will grow in almost any soil in which the moisture is not stagnant. The following account taken from a reliable source gives the method of cultivation adopted in Sumatra, one of the chief sources of supply :—The ground is marked out into squares by lines, intersecting each other at every six feet; at the points of intersection cuttings of the coral tree are planted. The trees from these cuttings are not allowed to grow more than 12 or 15 feet, which they attain in the second year, when they are topped; the branches also are annually lopped, little more being left than the rough stem which forms the support of the vines. The branches are lopped so as to give the stump a fan form, and thus afford a better shade to the pepper plant. When the coral tree is strong enough to act as a support, one or more cuttings of the vine from one to two feet long are planted close to it; the growth of the tree keeping pace with that of the vine. If left to itself the vine will attain a height of twenty feet and more, but for the purpose of cropping is restrained to about twelve feet. Between the second and third year it begins to bloom. The following season the stem is uncoiled from its support and is placed in a spiral form in a hole dug for the purpose close to its root, the top only being left above ground. Rooting afresh at every joint it grows again with renewed vigour, and the ensuing season bears a full crop. By some, instead of the buried coil method, the vines are cut down nearly close to the ground, and then allowed to grow again for their first crop; but the former method, providing as it does so many additional roots with which to extract food from the soil, is obviously best calculated to impart vigour to the plant. It is not regarded as a good practice to allow the first flowers to fruit and to take their produce before this turning-down process has been carried into effect. From the fourth to about the eighth year the vines continue to yield an annually improving crop, after which their productiveness gradually declines, until at a period of about four years later the amount of produce is no longer remunerative. The best cultivators provide against this tendency of the plant by having succession plantations or "gardens." When the plant begins bearing all suckers are removed, one or two stems only being allowed to

grow; the strongest suckers are used to replace misses or weakly plants, and so give uniformity to the plantation, or are applied in the formation of new "gardens." While the plants are young they are kept weeded, but the labour in this respect is reduced as the plants, by sheltering the ground, lessen the growth of weeds. Plantations vary in size from 500 to 3,000 vines; but, where the number is large, dividing hedges are grown so as to create plots of about 500 vines in each. In dry weather the plants are industriously watered. Flowers, green bunches of fruit, and mature berries may be seen at one time on the same vine; and from the first appearance of flowers about four months elapse before any of the fruit is sufficiently mature for gathering. Considerable judgment is required for determining this period. If left too long the ripe berries fall, and if the bunches are gathered prematurely the berries shrivel too much in drying and are less marketable. Unripe berries after drying go to dusty fragments in handling. In full vigour a pepper plant is very prolific, and each bunch containing from twenty to thirty berries —a single vine will sometimes produce from six to seven pounds of pepper; but the general average is very much less, probably not more than half a pound per vine over a whole plantation. The crop is an uncertain one, depending much on the seasons, and the fruit ripens irregularly over a greater part of the year; but a plantation in full bearing gives two crops in the year.

Simmonds states that some planters always raise their plants from seed, and that the vines so raised are said to bear for fourteen years; also that the crops from the latter are heavier and the berries larger. I do not, however, find this statement in any particular verified by practical writers upon the subject.

Method of Harvesting.—When the first berries ripen, which is evidenced by their turning red, the crop is gathered. In Java Dr. Meyen states that the crop is sometimes so great that the leaves of the plant cannot be seen for the immense quantity of berries. The exact point for commencing to gather requires, for reasons given before, some judgment, and can only be determined by experience. It is of course desirable that the vines shall not be injured, and for this reason, as well as for the purpose of reaching the top branches, the best cultivators use light triangular bamboo ladders, the operator collecting the fruit in a basket slung over his shoulder. The fruiting spikes or bunches are gathered whole and spread on mats in the sun to dry. As they dry, the spikes are turned over and either rubbed through the hands or trodden on for the purpose of separating the berries. After this they are sifted and winnowed to fit them for packing for market.

Good black pepper should be large-grained, not excessively wrinkled, and hard. It should contain no broken grains nor any which crumble on being rubbed. That it should be highly pungent and aromatic is a matter of course; and the failure of any one of these conditions evidences immaturity at time of gathering, or careless preparation.

White pepper is the same seed from the same plant, but deprived of its external skin. This is done by steeping the seed in water till the skin is soft, when it is rubbed off. The pungency of the pepper is, however, reduced by the process, and its value as a condiment is lessened; the only advantage being that it is easily ground and better satisfies a certain class of consumers, who prefer appearance to quality. Some small quantity of the white pepper of commerce consists of the first and largest berries which have fallen and bleached on the ground, whence they are carefully gathered and set aside. The pungency of these is, however, perhaps by exposure, still more deteriorated than that of the grains which are subjected to the soaking process. To further whiten the grains the process of bleaching, by means of chlorine and lime, is sometimes resorted to, but to the injury of the quality of the pepper.

"*Mignonette pepper*," or, as it is called in France where it is largely used, "Poivre Mignonette," is a term applied to ordinary pepper coarsely ground for the purpose of eating with oysters or to season ragouts. Some refer the name to the similarity in appearance of the article to the seed of the sweet-smelling plant known as mignonette; but it is more probable that that term implies "little favourite," and is applied in that sense as a distinctive trade phrase.

Uses.—Apart from its high value as a condiment, pepper is an important agent as a stimulant to the stomach and to promote digestion. It also acts as a warm carminative and gives tone to the system. In hot climates where the high temperature produces a tendency to debility of digestion, pepper seems to possess peculiar virtues; but there is no doubt that there is a point beyond which its use injures the stomach. Medicinally pepper is used in various ways. In India the berries are given as a stimulant and stomachic, and when roasted are used to stop vomiting in cholera. The root of the plant is employed to make a tonic stimulant and cordial, and also a liniment in chronic rheumatism. A watery infusion of pepper is also used as a gargle and as an antidote to arsenic; and the leaves boiled in oil are a remedy in scab. Ground pepper made into an ointment with lard is applied as a remedy in fistula, piles, etc., and for vermin in the human hair. Infused in spirits and water, pepper is a popular remedy in intermittent fever. For this purpose it is said to be more certain and speedy than quinine, and it is certainly cheaper as well as more readily attainable when wanted.

Adulterations.—The adulterations of pepper are manifold. The black berries of an entirely different plant, *Embelia ribes*, are mixed with the true article, which they resemble so closely as to be very difficult of detection; and at one time even imitation pepper-corns were manufactured and mixed with the true berries as a set-off against a heavy duty. Ground pepper is adulterated with linseed, mustard seed, sago, rice, starch, capsicums, and burnt crusts, ground to the same degree of fineness as the pepper; also with wheat and pea flour. The artificial berries may be detected by their falling to pieces in water, and most of the adulterations of ground pepper can be readily detected by means of the microscope.

What is known in commerce as "long pepper" consists of the fruiting spikes of *Piper longum*. These, which resemble the fruit of the common rib-grass, are gathered before maturity, are dried without detaching the seeds, and are sent to market in that form. They are warm and pungent, but possess only a slight aromatic odour. The roots and the thickest part of the stems of the *Piper longum* are cut up and dried in India for use medicinally. The virtues of the plant are sometimes extracted by spirits of wine, and so prepared form a powerful stimulant and tonic.

PERUVIAN MASTIC; PEPERINA.

(*Schinus molle.*—ANACARDIACEÆ.)

This is a small semi-deciduous graceful tree, a native of Brazil and Peru, attaining the height of 30 feet, with a light feathery drooping foliage. Its inconspicuous flowers are succeeded by pretty berries of rose-colour and highly polished. The term "molle" does not indicate any softness of the plant, but is an adaptation of the Peruvian name "mulli."

It is worth cultivating if only for the beauty of its foliage and berries, but it also possesses an interest from the usefulness of its products. A resinous gum, constituting a sort of mastic, exudes from the bark. This

gum makes a good dentifrice. Both bark and leaves are filled with a resinous matter, and from the leaves is also procured a white odoriferous substance resembling gum-elemi. From the bark, boiled in water, lotions are made, which are used for healing tumours and reducing inflammation. So heavily charged with resin are the leaves that, when immersed in water, they expel the resin with such violence as to appear, in consequence of the recoil, possessed of spontaneous motion. The presence of this resin is also indicated in the leaves by the fragrance with which, after rain, hey charge the air in the vicinity of the tree. From the berries is made either a vinous drink, a sort of honey, and of vinegar, according to the mode of treatment.

The tablelands of the Darling Downs suit this tree better than the coast. A resident on the Downs, describing one at Yandilla, writes me :—"My best *Schinus molle* is now three years old from the seed, and has grown ten feet high. At ——'s place, not far from here, there is a very large one, about twenty-five to thirty feet high. This, he tells me, has never had berries, but one of ours fruited last year in any quantity. The berries were as large as any I have seen in Italy, of a high pink colour, and the size of a small pea. This one tree fruits freely; another about the same age does not fruit at all yet.* We have some thirty young ones coming on to be planted out. The tree is semi-deciduous, losing a good many leaves in the winter. Last winter being so severe cut back the joints of the branches, but did not hurt the trees otherwise."

In the Southern Colonies I have seen many beautiful specimens, which added indescribable grace to the plantations of which they formed a feature.

* This is to be accounted for by the fact that the tree is diœcious—*i.e.*, the male flowers are borne on one individual and the female on another.

PUNEALA PLUM.

(*Flacourtia cataphracta.*—FLACOURTIACEÆ.)

This species and the three following are all natives of India. *F. cataphracta* is a thorny tree, attaining a height of from 20 to 30 feet. They are all found in arid and hot and often rocky situations, and are therefore peculiarly suitable for much of the coast country of Queensland.

The unripe fruit of all the species is extremely astringent, and, with the exception of that in question and the Madagascar plum, are so far inferior that they are no more than eatable even when quite ripe. Before eating them they should be rolled and pinched between the fingers until quite soft, a process which brings out the sweetness and blends the slight astringency, which even in the ripe fruit is observable in the skin. Besides being very pleasant eating when so treated it is excellent when cooked.

The fruit of this species is a round berry, the size of a small plum, of a deep, dull, purplish colour. About April it may be seen for sale in the fruiterers' shops in Queen-street, and the tree possesses sufficient excellence to deserve a place in all large gardens.

The young shoots and leaves have the flavour, without the bitterness, of rhubarb, and are reputed to possess astringent and stomachic qualities, and to be a useful remedy for diarrhœa and debility. The wood is close-grained, hard, and durable, and takes a fine polish.

Propagate from seed; but, as the seed is slow to germinate, it is a good plan to crush the fruit and sow without separating the pulp.

TOMI-TOMI.

(*Flacourtia inermis.*)

This is a middling-sized tree, producing berries somewhat similar but inferior to the preceding species, and fruiting a month or two later. The wood is of a reddish-brown colour, close-grained, hard, and heavy.

(*Flacourtia sapida.*)

A small tree, the fruit of which possesses no greater value than that of *F. inermis.* Timber of same character, but never to be obtained large.

(*Flacourtia sepiaria.*)

This species is a thorny shrub, attaining a height of not more than 6 feet. The thorns are numerous, close-set and sharp, and it makes a very good hedge, a small example of which may be seen at Bowen Park. The fruit of this species is smaller and inferior to any of the others, but is very abundant.

The bark rubbed up with oil is used as a remedy for gout and rheumatism.

MADAGASCAR PLUM.

(*Flacourtia ramontchi.*)

A native of Madagascar and India, but naturalised in Mauritius. It is a large deciduous and sometimes thorny shrub, with slender branches marked with grey dots; but under favourable circumstances it grows into a tree.

It is found on dry rocky hills, or in open, bare, warm localities, from the sea-level up to about 800 feet of elevation. The fruit is larger than that of the others, and when ripe has a violet black hue, and the flesh is more transparent.

The timber is close, fine, and even-grained, is very durable, and is not attacked by insects. It is much used for turnery, and in the manufacture of agricultural implements.

There would seem to be some confusion between the Indian species *F. sapida* and *F. ramontchi,* the former being also called by the latter name; but the true Madagascar plum is probably a distinct and superior species.

THE QUAMASH, KAMASS, or WILD HYACINTH.

(*Camassia esculenta.*—LILIACEÆ.)

This is a bulbous-rooted plant, resembling an onion in shape, and about the size of a hickory nut. It is a native of North America, where it is often found in great abundance. Travellers differ as to the nature of the soil which the plant affects, some giving it swampy plains and others rocky hills for its habitat.

It is a favourite food of the Indian tribes in its season, the digging of the Quamash being a time of high festival. The work of obtaining the bulbs devolves upon the women, who, however—especially the married—undertake it cheerfully, and vie with each other who shall bring in the heaviest lot; as their capacity for this special labour is held by the men to be a sort of test of their fitness for the duties of wives.

When eaten raw the taste is pleasant and mucilaginous ; when boiled it somewhat resembles that of a potato. The time for gathering selected by the Indians appears to be immediately after the plant has flowered ; at which stage, doubtless, their instincts teach them that the bulb is most rich in the farina which constitutes the value of the root for food.

The Indian mode of preparing it for future use is to dig a pit, line it with stones, upon which a fire is made. When heated sufficiently, the stones are swept clean and the roots are heaped upon them ; grass or twigs are next laid over the pile, and, finally, a covering of earth. After several days the pit is uncovered, when the white roots are found to be converted into a thoroughly cooked, dark-brown, homogeneous mass of about the consistency of soft glue, and as sweet as molasses.

Cooked in this manner, the roots are often made into large cakes, by working and pressing them together ; and, when slightly dried in the sun, they become pliable and tough, and look like plugs of black navy tobacco. Its colour in this form does not recommend it to the taste ; but it is sweet, mucilaginous, and as agreeable as the fresh root, excepting a slight smoky flavour acquired in baking. In this pressed form it keeps softer than in the raw state or when simply cooked, and may be kept for a year or more.

The roots when boiled in water yield a very good molasses, which is much prized, and is used on important festival occasions.

In many of its forms, but especially in the cakes just described, the Quamash requires caution in eating, as it has an aperient effect until the stomach becomes accustomed to it.

The flower-stalks grow from 12 to 18 inches high, and bear from 12 to 20 blue or white flowers, something like the hyacinth, and it makes a pretty garden plant. It would thrive best on the tablelands.

It is propagated either from bulbs or seeds.

QUININE TREE.

(*Cinchona.*—RUBIACEÆ.)

This remarkable tree, with its numerous species and varieties, plays a very important part in the economy of life, and its history falls little short of the romantic. From the discovery of its merits by the Jesuits in the early history of Spanish occupation in America, down to the adventurous search for plants and seeds organised by the Indian Government, and so admirably carried out by Markham and his coadjutors, the history of the Cinchona is replete with interest. A denizen originally of certain mountainous tracts of country in South America and Brazil, it has during the last twenty years been naturalised in corresponding climates and elevations in the East Indies, Jamaica, Java, and Ceylon ; and is very largely grown with eminent success not only in the production of its staple, but—what is more remarkable, considering how little was known of the habits of the tree, and that the knowledge attained has been developed under Governmental management,—financially also. While still principally cultivated, and that on a very large scale, in Government establishments, private enterprise is rapidly engaging in the production ; and as the markets become better supplied, the various Governments, under whose auspices the planter has been educated in the industry, will probably consider their functions at an end, and will stand on one side and permit the industry to flow in the ordinary channels of commerce.

The lead has been so well given in other British possessions, and the industrial and scientific literature of the Cinchona is now so extensive, that in Queensland there is no more occasion, than there probably exists the disposition, on the part of the Government, to actively concern themselves in the endeavour to establish quinine production as an industry. The limits of these pages forbid my giving the reader much that would be pleasant to write and interesting to read of the history of the Cinchona over a period of more than four hundred years, during which the virtues of the tree under its earlier names of Peruvian or Jesuits' bark have been known.

The climate required for the cinchona is peculiar and to be obtained only under limited conditions, which exclude, as unfit, millions of acres of the finest soil. The different species thrive only at elevations specially suited to them, but none of them will submit to the sea-level. It may be also laid down as absolute, that many of the species will not live within the influence of frost, and that, while some will bear a few degrees of frost without absolutely succumbing, there can be no quinine production under such conditions.

The purpose of this paper will be best served by not overloading it with a list of known species and varieties, or with much other matter appertaining to the subject and of no little value, but which can be furnished at a future time if it be found that the enterprise of Queensland colonists leads to any substantial experiments in cinchona culture. The plant so seldom comes true from seed that it is of the greatest importance to go to a reliable source for the first material upon which to operate. *C. succirubra*, which is the species most extensively planted hitherto, will grow as low as 800 feet and as high as 5,000 feet above sea-level ; *C. calisaya*, to which attention is much turned in India now, from 1,500 to 3,000 feet. The range of elevations over which the genus is found naturally or in cultivation is very great, starting at *800 under cultivation and going as high as 11,000 on the Peruvian Andes. For the early stages of experiment in Queensland it may be well to concentrate attention to *C. succirubra, C. Ledgeriana, and C. calisaya*, which are rich in alkaloids, hardy and robust, especially the former, and will succeed at comparatively low elevations. Should intending planters, through the intervention of the Queensland Government with the East or West Indian authorities, be able to secure true samples of high-class species, such as *Ledgeriana*, every effort should be made to find a home for them ; but I do not advise anyone to enter upon this industry unless the plants or seeds with which he begins come from a sure source, and are guaranteed by competent authority to be what they profess.

The soil preferred by all the species alike is a rich friable open kind, and they insist upon a perfectly drained subsoil. Without this latter condition it is mere waste of time to attempt the cultivation. According as the different species are grown at the elevation most suited to each, the Cinchona is a forest tree or a mere shrub.

Comparing various methods, all by good authorities, for raising plants, I select the following directions from Mr. Morris, the Director of Plantations in Jamaica, as plain and concise, and having stood the test of experience :—

" For raising small quantities of plants—say from 30,000 to 80,000—it is desirable to sow the seed in small shallow boxes under cover, where they can be conveniently attended to.

* Since writing this article I find it stated in the *Ceylon Tropical Agriculturist*, 7th October, 1882, that *C. Ledgeriana, C. pubescens*, and *C. Condaminea* are growing luxuriantly at an elevation as low as 200 feet above the sea. It had still, however, to be determined if the quality of the bark was as good at that elevation; but it was held that, if Cinchona bark could be produced at low elevations yielding bark only moderately rich in alkaloids, the whole enterprise of Cinchona cultivation would be revolutionised.

"The boxes may be of any size as regards length and breadth, but should not be more than about 3 or 4 inches deep. Ordinary brandy or wine cases reduced to the above depth answer well.

"To promote drainage, holes about $\frac{3}{4}$-inch in diameter should be made in the bottom of the boxes at distances of about 6 inches apart. The inside of the boxes should be treated with whitewash, or thoroughly dusted with quicklime, to prevent mouldiness of the soil and subsequent injury to the young seedlings. Over the holes in the bottom of the boxes place pieces of broken pots or brick, and cover the surface to the depth of 1 inch with rubble or broken stones.

"*Soil.*—The soil for the boxes should consist of one-third of leaf-mould, or that kind of soil of a black peaty character which is often to be found under large trees in the forest; one-third of good ordinary garden soil and one-third of sharp sand or fine river gravel These should be mixed thoroughly together and passed through a $\frac{1}{4}$-inch sieve.

"The boxes may then be filled within $\frac{1}{4}$-inch of the top, with the sifted soil placed over the broken stones, etc., and slightly pressed, so as to present an even, unbroken surface.

"*Sowing the Seed.*—After slightly watering the soil in the boxes, the Cinchona seed, which is very light and small, should be sprinkled rather thickly over the surface, so as to cover nearly every part with a rich brown tint. When this has been done, take a small quantity of the fine sifted soil, mentioned above, and sprinkle it over the seeds, *barely covering them.*

"*Watering and Shading.*—The boxes should then be placed in the shade, sheltered from the sun, wind and rain, and kept regularly watered, daily, with the finest possible spray from a watering can. Under the conditions above mentioned, the seeds will begin to germinate in about 3 or 4 weeks. They will require regular watering, however, till they are $1\frac{1}{2}$ or 2 inches high, when they are ready for the nurseries.

"*Nursery Beds.*—When seedlings have been raised in boxes, and are about $1\frac{1}{2}$ or 2 inches high, the next step is to transplant them into the nurseries. In selecting situations for seed-beds and nurseries, it should be borne in mind that a sheltered situation, with a plentiful supply of water, are no less important considerations than nearness to the land intended to be planted.

"The beds for the nurseries should be laid out in every respect as for seed-beds—*i.e.*, about 3 feet wide, with paths $2\frac{1}{2}$ feet wide, treated on the surface with a mixture of good soil, and arranged in rows.

"Before the seedlings are transferred to these beds, it would be well to prepare beforehand the necessary materials for shading them. These may consist of long straight wattles, supported on forked sticks, and covered with grass or other suitable material. Side shading is also advisable, especially on the west side.

"Pricking out seedlings into nurseries is a work requiring great care; but with a little experience it can be done very successfully and expeditiously. The seedlings being about $1\frac{1}{2}$ or 2 inches high may be carried in the boxes into the nursery. The beds already prepared for them should receive a good watering, and be pressed evenly by gentle tapping with a piece of board. The person about to prick out should be provided with a small wooden peg about 4 or 5 inches long and $\frac{3}{4}$-inch in diameter at one end, tapering to a dull rounded point at the other. Taking up a seedling carefully by the leaves with the left hand, a small hole should be made with the peg in the right hand, just deep enough to take the tender roots of the seedlings without bending or crushing them. When placed in the hole, the soil

should be pressed closely to the rootlets by means of the peg, and the seedling left firmly fixed with its leaves and stem well above ground. The seedlings should be placed in rows at regular distances apart, so as to allow about 2 inches between each plant.

"As soon as an appreciable number of seedlings have been pricked out, shading should be immediately placed over them to prevent injury from sun or rain.

"The nursery beds will require regular watering for some time; but when the plants are about 4 or 5 inches high it would be well to remove the shading, little by little, in order that the plants may become gradually hardened, and ultimately fit for transplanting to their permanent places in the field."

The final planting out requires care, and should be done by, or at least under the supervision of, an experienced and intelligent workman. Everything should be ready for the operation, and the plants not be removed from the nursery until the holes are ready for them. It is hardly necessary to say that the heats of summer should have passed and the weather be suitably moist. These conditions observed, there is no more mystery in planting out the Cinchona than in the case of any other plant. The great care exercised is necessitated by the tenderness and the value of the plants, and the importance of not wasting time and costly material by bad work or the employment of unskilled hands.

The distance apart between the young trees is rarely, even in the case of the robust *C. succirubra*, more than 4 feet each way. Close planting results in straight stems, and acts as a shade to the superficial rootlets which the plant has a tendency to throw out. In due course the trees are thinned out, but the cost of the additional labour is recouped wholly or in part by the bark obtained from the discarded saplings.

Temporary shading of the young plants in a rough way and with any handy material is desirable. The intervals between the trees must be kept clear of weeds until the shade of the trees themselves prevents the weeds from growing; but the hoe should be used as little as possible, and then with care so as to avoid injury to the superficial roots of the plants.

The importance of propagating species of well-ascertained value renders peculiarly interesting the fact that the Cinchona is readily increased by layers, cuttings, and buds. Mr. McIvor, the Superintendent of the Government Cinchona Plantations on the Neilgherries, to whom the industry in its early years in India is very greatly indebted, gives the following instructions for cultivating by each of these methods:—

"*Propagation by Layers.*—As soon as the plants have attained a height of from 10 to 15 inches they are propagated by being layered. In this way they are found to root readily in about six weeks, or two months at the latest, and the plants, by being bent down, break or throw out shoots from every bud along the whole length of the stem; and not only this, but many latent buds are developed and a fine growth of young wood produced for succeeding layers and cuttings. In this way each branch or shoot is treated as it gains sufficient size. The principle of layering we have adopted is somewhat different from that usually practised; as we found, when cut, the juice of the cinchonas flowed so freely from the wound that if merely placed in the soil it was apt to cause mildew and rot. To remedy this, a piece of perfectly dry brick is placed into the cut as soon as it is made; this absorbs the juice and effectually prevents the ill effects above mentioned. The layers when well rooted are removed from the parent plant, potted off, and kept in a close atmosphere for a few days until they become established. In removing the layers great care must be taken, for if they are cut off before the shoots above the layer have attained a good size, and

their leaves fairly developed, the stock or parent plant is almost certain to die off. The reason of this is, the sap flows into the plant with equal vigour, but cannot be elaborated because of the removal of the leaves attached to the layer, and consequently it ferments and causes rot in the parent plant.

"*Propagation by Cuttings.*—Cuttings of from three to five inches in length, if planted in beds in the open air and partially shaded, will form roots in from three to five months, and when the rapid increase of a plant is not an object, this is perhaps the safest and cheapest plan of propagation; but where the object is to increase the plants rapidly a propagating house is indispensable. With the aid of a propagating house the youngest wood that can be procured is the best adapted for making cuttings, as young tender shoots, a fortnight or three weeks old, form roots in a very short space of time; the majority of the cuttings being invariably rooted within a month. It is, however, difficult to deal with this description of wood, and to secure success requires a great amount of care. The earth in which these cuttings are placed is kept a little drier than for seeds. The cuttings on being made are placed around the sides of the pots, the cut end of each being pressed firmly on a piece of dry brick. Each pot contains from 20 to 25 cuttings, and, as they are filled, they are immediately removed to the propagating frames and plunged into beds of damp sand, on a bottom heat of about 75 degrees Fahr.

"The cuttings are now carefully watched, the surface and the leaves being moistened by a fine syringe when the atmosphere in the frames appears dry; they are, however, never watered, it being very necessary to ensure success to avoid this, as we have invariably found that when the earth is once watered it causes the cuttings to damp off and seriously retards their rooting. The cause of this appears to be that the cuttings not only suffer from excess of damp, but when the soil is watered in the usual way after the cuttings are placed in the pots, by its expansion and adhesion from the action of the water its particles are forced far too close together to be beneficial for the development of roots. With young wood our losses with cuttings have recently not averaged 3 per cent. In removing the cuttings from the stock plant, one or two pairs of leaves and buds should, if possible, be left between the plant and the part cut; this is done in order not to decrease the succeeding supplies of young wood, which would be the case if the cut was made close to the parent stem. Another circumstance, very necessary to be attended to in order to insure success, is to be careful to place each cutting as it is made into the pot with the cut end on a piece of dry brick; this must be attended to, because where the cut is made the juice begins to flow, and this juice if not immediately absorbed by the dry brick causes mildew and rot. When the cuttings are placed in the frames they are exposed to as much light as they can bear without flagging.

"*Propagation by Buds.*—It having occurred to me that the plants could be successfully propagated by leaves with the bud attached, and as this method offered very considerable advantages in producing a large number of plants from a limited supply of wood, we resolved to attempt the experiment, which has been carried out most satisfactorily. The whole secret of success depends entirely on the amount of moisture given; if this is supplied in excess, they rot immediately, even in a day, but if sufficient care is exercised the losses will not exceed 3 or 4 per cent., and this percentage has not been exceeded in many thousands we have propagated in this way. By this method, fine plants are obtained in every respect resembling strong healthy seedlings. The period required to form roots is nearly the same in all the species, varying from three to six weeks. It may be observed that it is not indispensable that a leaf be attached to the bud; this is, no doubt, a great advantage, although we have struck many buds without any leaf attached.

"The usual way in which we prepare the buds is to remove the point of the shoots for a cutting; the stem is then divided near the middle of each internode, split down the centre, and immediately placed upon the brick in the pot, the bud itself being covered with about ¼-inch of soil, while the leaf, of course, projects above the surface. The pots are then plunged in damp sand, and treated in every respect the same as the cuttings."

The bark harvest is reaped by various methods—by cutting down the tree, by uprooting it for the sake of the richer bark covering the roots, by coppicing much in the same way as in the case of the cinnamon, and by what is known as the mossing process. By the latter method the bark of an eight-year old tree is removed, as far as the workman can reach, in alternate ribbon-like strips of 1½ inches wide, the intervening strips being left on the tree. After this process the trunk is covered all round with moss, tied on with fibre of some kind. If this is done in damp weather the wounds soon begin to heal, and in about 22 months are covered with a thicker layer of bark, and richer in crystallisable quinine than the original bark. At the end of six or twelve months after the first stripping the intervening strips are taken off, and mossed up. There appears to be no limit to the number of times that the process may be repeated. Under unskilful treatment, and in dry seasons, it has not always been equally successful; and some more modern authorities than Mr. McIvor who first applied the mossing system—as for instance Dr. George King—regard it as open to considerable objections.

One of the most valuable and interesting results which have flowed from the success of the Cinchona in India, has been the manufacture of a cheap febrifuge, which has proved a remedy in malarious fevers scarcely if at all inferior to quinine. Most of the bark used has been derived from thinnings and prunings undertaken from time to time in the interests of the trees; and is chiefly what is known as red bark, which is not very rich in quinine, and the quinine in which is difficult of extraction. The process is thus described:—"The bark, roughly powdered, is first exhausted with cold acidulated water, and the resultant liquor precipitated by a caustic alkali. No fuel is required except what may be found necessary to dry the alkaloid obtained. No expensive machinery is involved, the only plant required being some wooden tubes and calico filters. Skilled labour is unnecessary, and very little supervision is required." The cost of the product in 1876 was under two shillings an ounce, which it was confidently expected would be further reduced by means of more complete methods of extraction. Dr. George King, writing of it in 1876, says "with a good febrifuge at a cheap price, malarious fever should be robbed of three-fourths of its annual victims, and the poor of this land be thus attached to their paternal Government by yet another bond." This opinion has been largely verified by actual results.

One great advantage of the production of bark by cultivation consists in its reaching the market more purely. Much of the bark brought from its native habitat used to arrive in a half-decayed state mixed with fragments of other vegetable and extraneous substances. But the greatest danger of a spurious article finding its way into consumption commences at the mills, whence bark powder is issued at a price which itself is an evidence that it cannot be pure, and yet the very cheapness forms an irresistible attraction to many drug vendors. Mahogany and oak sawdust are among the principal adulterants.

As an encouragement to settlers on the northern coast lands of Queensland, to test some of their mountain slopes for Cinchona, I would remind them that they have an enormous advantage in the experience of India, Java, and Jamaica. The practice and science of Cinchona-growing is now not only well understood, but is plainly written. The knowledge has been attained

through many mistakes and much failure. In India so much was this the case that many who were fair judges had grave doubts of ultimate success; while in Jamaica more than once were further efforts on the point of being abandoned for want of knowledge of the conditions necessary to success.

At the present time the picture is so much reversed that we find Cinchona planters in Ceylon making loud complaints that the Indian Government, tempted by the profits of bark production, continue to produce beyond the point at which they proved production to be profitable; and are now interfering with private enterprise.

RAMBUTAN.

(*Nephelium lappaceum.*—SAPINDACEÆ.)

A small tree, native of the Malayan Archipelago. The fruit, which is bright-red when ripe, is of oval form, and two inches long. It is covered with long soft thick hairs, from which it derives its vernacular name; the word "rambut" meaning "hair." The fruit, which contains a pleasant acidulous pulp, is worth cultivation, but requires for its perfection to be grown in a moist warm climate.

The Rambutan likes a rich light loamy soil, and can be propagated either by seeds or cuttings.

SOLA-PITH PLANT.

(*Œschynomene aspera.*—LEGUMINOSÆ.)

This is native of many parts of tropical Asia and Africa, but in India alone is it to any large extent utilised. The name "Sola," "Shola," or "Solah," as it is indifferently written, probably takes its origin in the fact that it is found in marshy localities; the term "Solar" as applied by the English hat-makers to the hats made from its pith being a misnomer arising from the protection from sun-heat afforded by this kind of head covering.

The botanical name *Œschynomene* is derived from a Greek word signifying "to be modest," and was given by Pliny to one of the genus, the leaves of which were to some extent sensitive like the so-called "sensitive plant," whose leaves modestly shrink from contact with the hand.

The *Sola* is a tall, erect, perennial, swamp plant. It flourishes on the margins of swamps and on the low banks of rivers and streams. The erect and sometimes floating stems, which are very stout (2 to 3 inches in diameter) in proportion to the size of the plant, are full of a white pith, or rather a very light and spongy wood. The seed-pods are jointed on long stalks, with prickly tubercles on the middle of each joint. The flowers, which are produced during the rainy and cool season, are of a dark orange colour.

The *Sola* must be ranked among the plants of industrial value, contributing both to the health and comfort of man in the tropics; and it possesses the obvious advantage, by its naturalisation, of rendering productive waste spots of the earth, and of yielding its product without cultivation.

It does not, says a writer on the subject, present itself with that retinue of eminent properties so commonly attributed to plants which it is desired to bring into common use. But however unassuming those pertaining to it may be, they are none the less of such a nature as to be capable of utilisa-

tion, whether for the comfort or the health of the inhabitants of inter-tropical regions. Moreover, it would be advantageous to acclimatise in our colonies a plant that will thrive without culture on some of our most value-less lands. It may become the object of an industry which, without demanding special implements, would occupy the leisure hours profitably.

The chief virtue of the *Sola* plant lies in the very light pith-like wood of the large mature stems. This is quite white, and the polish of its grain gives it very much the appearance of alabaster The facility with which it can be worked permits of its being cut into statuettes, children's toys, models of flowers, monuments, buildings, and various other things of like character, and it is also used in the manufacture of fireworks.

Its extreme lightness fits it for many of the purposes for which cork is used, such as fishing floats and swimming jackets, and for other purposes in which elasticity and lightness combined are required. It is strongly recommended as a packing round shafts in delicate machinery, to close joints and prevent friction ; and is reputed to be preferable to all other substances for these purposes, being softer and less gritty than cork, and consequently not wearing the machinery so fast.

Another most valuable quality of this material consists in its being a non-conductor of heat ; which leads to its enormous use in the manufacture of the hats and helmets so well known to Queenslanders as well as to Indians. For domestic purposes in a hot climate the *Sola* pith is capable of being put to various uses. " In India," says Dr. Collas, " one of the greatest enjoyments consists in cool drinks ; accordingly the property possessed by this plant as a non-conductor of heat could not fail to be turned to account in order to preserve to iced drinks and side-dishes a temperature independent of that of the surrounding air. This is attained by making cases with the stems of the *Sola* for the decanters, bottles, and glasses, and covers for the creams, etc. It is truly surprising at what a low temperature the drink and dishes may be maintained when the atmosphere is scorching. Protected by these shades and covered with crochet-work, they contribute to the nice appearance of the table."

This material is also used, in the same manner as sheet cork, by the naturalist for lining insect cases.

In India the *Sola* hat is much used alike by soldiers and civilians of all classes, being not only light and impermeable to heat, but cheap. It has therefore almost wholly superseded straw, felt, and Panama hats. The fact, however, of the material being so bad a conductor of heat renders ventilation of these hats indispensable ; otherwise the head would be kept in a vapour bath, which if not so dangerous as exposure to the sun would be hardly more pleasant.

For some of the purposes to which the wood is applied, the stems are cut into thin strips which are pasted together, while for others it is solidified by pressure.

The stems are gathered in the driest months, which in India are March and April.

The *Sola* was some years ago introduced into Queensland through the instrumentality of Baron Mueller ; but its treatment was not well understood, and it has probably died out. It is by no means an inelegant plant, and would form a marked feature of our lagoons ; as has been the case with the *Papyrus antiquorum* (Moses' Bullrush), which was introduced by the writer some ten years ago, and flourishes abundantly, although its uses have not been properly tested.

SUNFLOWER.

(*Helianthus annuus.*—COMPOSITÆ.)

A common garden plant, known to all for its obtrusively showy flowers, but rather looked down upon as only fit for the roadside cottage, and finding no fitting place in a well ordered garden. And this is about the sum of the knowledge of most people about one of the most useful plants of the world's surface, and one the economic properties of which are most easily and inexpensively developed. Recently the Sunflower, presumably for its gaudy unfitness, has come into notoriety as a copy for articles of female adornment; but while this grotesque application of the flower will pass away as do other follies of fashion, to become the laughing-stock of another generation, the value of flower, fruit, leaf, root and stem, to draw attention to which this article is written, remains to all time, and its development will increase as cultivators of the soil become more intelligent and less lethargic.

Helianthus annuus and other species have been so long in cultivation, and in so many parts of the world, that the origin of the species in question is somewhat lost. It is, however, said to be a native of Mexico and Peru; and the industrial importance of the plant is evidenced by the rapidity with which it has become a regular crop among two of the greatest nations of the world, Russia and Germany, while in England, France, Portugal, Holland, Jamaica and elsewhere, it is more or less in regular cultivation for some or other of its many uses.

The theory of the Sunflower, from which it derives its name, is that it always turns its face to the sun. Here is a pretty picture: "Nothing can be a more complete ideal representative of the sun than the gigantic Sunflower with its golden rays; it is dedicated with great propriety to the sun, which it never ceases to adore while the earth is illumined by his light. When he sinks into the West, the flowers of *Helianthus* are turned towards him, and when he rises in the East, the flowers are again ready to be cherished by the first influence of his beams." The romance of this picture, and the pretty tradition which gave rise to the name, are disturbed by the fact that careful observation has failed to verify the theory. On the contrary, flowers may be seen on the same stem pointing in all directions. The real foundation for the tradition lies in the fact that, while the plants are growing, and before they attain their full height and the flower-buds open, the head of the plant inclines to the east in the morning, and to the west in the afternoon. It is hardly necessary, however, to seek further for the origin of the name than the general aspect of the flower, which in size, colour, and form is more like the sun than any other known flower.

The uses to which the plant is put are numerous, but those of the seed are the most important. This, in its whole state, is unrivalled as a fattening feed for pigs, sheep, poultry, pigeons, rabbits, etc. Fed to fowls it makes them lay better, and to pheasants it makes the birds plumper and improves their plumage. Roasted and ground the seeds make a good substitute for coffee. In Tartary the larger seeds are boiled and eaten; and several species of sunflower are among the food products of the North American Indians. The seeds are eaten either raw or pounded up with other substances, and made into flat cakes and dried in the sun, in which form they appear to be very palatable to the Indians, and are undoubtedly nutritious. In some parts of the Continent, a nutritious and easily digested porridge is made from the seeds, as a food for infants.

Ground into meal they make, either with or without admixture of flour or other meal, a wholesome and nutritious bread, and the finer flour is used to make a light and palatable teacake. Boiled in alum water the seeds yield a blue colouring matter.

Of equal if not superior industrial importance to that of the uses already enumerated, is the fixed oil obtainable from the seeds by expression. This is little if at all inferior to olive oil, and is used for all the purposes to which that oil is adapted. Dr. Schomburghk, writing in 1868, states, from official sources of information, that in Russia alone, in 1866, 5,000 tons of oil, of which the value was £250,000, were produced.

For the table it is said to be unsurpassed, and is, in fact, largely used. In woollen factories, in the manufacture of candles and fine soaps, and for lighting, it is equally useful.

The yield of oil is 40 per cent., and the oilcake fed to cattle is wholesome and fattening, being considered superior to that of linseed. The oil is of a pale-yellow colour, somewhat thicker than that of hempseed. It dries slowly, and is used for painting as a drying oil. At an ordinary temperature it becomes turbid, and solidifies completely at 16°.

The fresh leaves make a good fodder, which is eaten with avidity by cattle ; and when sun-dried and powdered they are mixed with bran and fed to cattle with the best effect. Another use to which the leaves is put is in the manufacture of a kind of cigar as a remedy in asthma, for which purpose they are said to be equal to the *Datura stramonium*, a well-known remedy in pectoral affections.

Nor is the stalk of less value than the leaves, as it produces a good textile fibre of some brilliancy, which is supposed to be mixed by the Chinese with silk in some of their silk fabrics. The Chinese are very large growers of the plant, and extract the fibre by a similar process to that applied to flax.

But if not used for their fibre, the stalks when burnt yield a large quantity—not less than 10 per cent.—of excellent potash. In Russia the manufacture of potash from this source is an extensive industry. The pith is available in place of "Moxa," a vegetable substance much in use by the Chinese as a cautery; for which purpose it is laid upon the part affected and set on fire, burning slowly, without flame, much like the fungus commonly known as German tinder. The sunflower pith is well adapted for this purpose, the nitre it contains enabling it to burn without being blown upon.

The fresh flowers, before the seed matures, have their own distinct value, producing a brilliant yellow dye which stands well; while for bees, the Sunflower is unrivalled, large quantities of honey and wax being obtained therefrom.

When a little short of full bloom they furnish a dish for the table which bears favourable comparison with the artichoke.

Loudon states that the whole plant, particularly the flower, exudes a thin, pellucid, odorous resin, resembling Venice turpentine ; but I cannot learn that this is put to any separate industrial use.

But one of the most remarkable properties of the plant has still to be described—namely, its large power of absorbing and exhaling moisture. The actual extent of this power is differently stated by authorities, but the lowest estimate given of the exhalation of the Sunflower is $1\frac{1}{2}$ lbs. of water within twenty-four hours. Another authority states that it will lose nearly 2 lbs. by perspiration in twelve hours, and that, taking all things into account, a Sunflower perspires seventeen times more than a man. On account of this property it is recommended to be planted round swamps as a barrier against malaria ; and it has been used for this object with undoubted effect.

The cultivation of the Sunflower is very simple, and it yields a quick crop. Under favourable conditions the ripe seed have been reaped within ten weeks of sowing. It is not particular as to soil, but prefers it light, rich, and well drained. Soils less well suited only make the difference of a

smaller harvest. It is advisable to sow early, so as to secure perfect maturity before the cold season. The quantity of seed to the acre will vary from 4 to 6 lbs., according to quality and state of the soil. It should be sown in drills, the distances between the rows and in the drills also varying with the conditions ; 18 inches between the rows, and the seed dibbled in at intervals of 12 inches, make good distances ; the plants being thinned out (if found necessary) to ensure full exposure to the sun—a condition essential to securing good heads of seed. A sufficient interval between the plants is the more necessary from their habit of spreading their branches and heads in successive layers over one another. When 12 inches high, the plants benefit by a slight earthing up.

The only objection that appears to the cultivation arises from the great inequality with which the heads ripen; but this objection is thought to be overcome by the cultivation of late years of a species producing only one large flower to each plant.

A yield of 50 bushels to the acre, under favourable conditions, is not uncommon.

In the year 1873 some interesting experiments were made at Bangalore, in India, by Colonel Boddam to test the value of the Sunflower as a cultivated plant. The seed used was the Giant Russian, which is double the size of the ordinary seed. Six pounds were sown in drills 1 yard apart on 29th August, 1873, and the plants were harvested in the last week of December. They were 7 to 8 feet high, each bearing one large head; the largest of six taken from a plot of average growth was 35 inches in circumference, weighed 3 lbs., and contained 1,875 seeds. The others ranged from 29 to 25 inches in circumference, averaging about 1 lb. weight, and the seeds varying in number from 1,000 to 1,400. The leaves were sun-dried and pounded, and made 500 lbs. of dry fodder, which, mixed with meal or bran, was fed to milch cows with good effect. The dried leaves will keep for a long time. The seed, after being husked, was made into coarse meal, which was pressed for oil, about 1 cwt. of the meal yielding 3 gallons of oil and 35 lbs. of oil cake. Colonel Boddam says that the empty seed-heads and stalks make good fuel, and the potash which they produced made an excellent manure for coffee and tobacco.

I strongly urge the sunflower upon the attention of cultivators of the soil in Queensland as a certain source of profit, and one which would help them to a better average income when rust attacks the wheat, or disease reappears in the banana or the sugarcane. It will grow in almost any soil and in any climate. It will bear cold or heat, drought or rain. There are oilmills in the adjoining colonies if the grower does not care to erect a simple mill for himself ; or he can ship the seed, which keeps and carries well, to the home market where there exists a constant demand for it. The seed presents the further advantage as a crop that it can be gathered and stored until the grower has time and opportunity to turn it into money.

The Sunflower is subject to no disease and to no climatic disqualification. It can be tried in any odd corner of the farm, and if successful is as simple as maize to grow upon a larger scale next year ; but the plant has many more uses than maize, and is a much more sure and unvarying source of profit. Like many other productions which are overlooked in the eager pursuit of sugar, wheat, bananas, and maize, the Sunflower, which grows with greater certainty and superior luxuriance, needs only to be extensively cultivated to add another source of wealth to the already unrivalled resources of Queensland.

TAMARIND.

(*Tamarindus Indica.*—LEGUMINOSÆ.)

This tree is a native of both the East and West Indies, of Mauritius, Arabia, and Egypt, and of the Islands of the Indian Archipelago; and is cultivated throughout tropical Asia and in Africa. Two species are known, viz., *Tamarindus indica*—the East Indian tamarind—the pod of which is elongated, being six times longer than it is broad, and containing from six to twelve seeds; and *Tamarindus occidentalis*—the West Indian tamarind —the pod of which is short, being only three times longer than it is broad, and containing from one to four seeds. Indian authorities speak of three varieties, known as "the sour-fruited," "the sweetish-fruited," and "the red-fruited," but I am unable to discover what is the botanical distinction between them. The tamarind, under favourable circumstances, is a large, beautiful, and spreading tree, attaining the height of forty to eighty feet; and in India and Java is regarded as one of the finest trees for avenue and clump purposes. The feathery, acacia-like foliage, and the clustering yellow and red flowers, which come out from the sides of the branches, make the tree one of the most ornamental for these purposes and for large gardens. To attain perfection the soil must be both deep and good; and as the fruit remains a tedious and unusual time upon the tree, a very moist climate is inimical to the maturing of the pods. Crawfurd, in his "Indian Archipelago," says:—"The soil and climate of Java bring the fruit to the greatest perfection, and from that island it is an article of export to the other countries of the Archipelago, as well as abroad. Hence the tree and fruit are called in the Malay language *Asam Jawa*, or Javanese acid. The tree is, however, indigenous in most of the islands, and known in each language by a distinct native term. The word *Asam*, common to most of the languages as a synonym, is an epithet of the languages of the western islands, meaning "sour," from the tamarind being the acid in universal use for almost every culinary and medicinal purpose.

The flat pod, with its shiny brown seed, is so well known as to be hardly necessary to describe. When unripe it is so intensely acid as to be barely retainable in the mouth; but this quality makes it very valuable to allay thirst. A gentleman in Northern Queensland, whose avocations require him to travel a good deal during the height of summer, has told me that he always keeps a few tamarind pods in his saddle pocket, and with their assistance can go for many hours without drinking. The ripe pod has an external brittle shell, easily detached, and leaving the seed enveloped in a brown pulp, very acid, and somewhat mucilaginous, mixed with sundry fibrous strings. Still more internal is a thin membraneous skin, which is the final covering of the seeds.

There are several methods of preserving tamarinds, all simple. By one method the fruit, divested of its outer brittle husk, is packed in layers in a cask, and filled up with boiling syrup. A modification of this method, simpler still, but not producing quite such good-looking results, is to ladle sugar direct from the boilers into the cask of fruit—a method commended to our sugar-growers on the northern coast, where the tamarind-tree bears so abundantly. Another method of preserving, which, however, appears to be stated with some diffidence, is by the pouring of plain boiling water over the fruit. A further method, adopted both in the East and West Indies, and which is successfully used by more than one grower in this colony, is to alternate layers of the fruit with layers of dry sugar, and press all firm. This makes a perfect preserve without any cooking at all; while the vitality of the seeds of tamarinds thus prepared is not affected.

For the table a more elegant result is produced by using a syrup which has been clarified by means of white of eggs. The preserve so made has a transparent golden appearance, which in a glass dish is very effective.

Some of the tamarinds which reach the market from the West Indies are more or less deleterious from having been preserved in copper boilers; and it is well, as a precaution when eating imported preserve, to test it for copper by leaving a clean steel knife in the jar for a short time. If copper be present it will display itself in its metallic colour upon the knife.

The tamarind is a very important ingredient in Eastern cookery, especially in curries; and a dish known as "tamarind fish," of great delicacy, is made by a preparation of this fruit, with "white pomfrets," a famous Indian fish. The mode of preparation is to cut the fish into transverse slices and preserve it in kegs with the acid pulp of the tamarind.

In the West Indies the fruit forms an ingredient of rum-punch; and is also found convertible into good vinegar.

The uses of the tamarind are by no means confined to those of an article of food. In medicine, although possessing no special value, they are a useful appliance of the sick room in making cooling drinks and acting as a gentle laxative. They owe their grateful acidity to the presence of harmless vegetable acids, viz., citric, malic, and tartaric. Tamarind whey, a very pleasant form in which to prepare a drink for the feverish patient, is made by boiling the pulp of the fruit with fresh milk and straining; and a sweetened infusion is an excellent thing to give, as a mild aperient, to children who are difficult to persuade to take medicine.

Among the pulps used in the adulteration of opium, that of the tamarind is the most common.

In commerce the tamarind takes three forms, viz.:—(1.) The black, from the East Indies, in 2 cwt. casks, in the form of a dark-brown or black paste, consisting of the pulp and seeds and some fibres. It does not contain any sugar, and the blacker the colour and more free from fibre and seeds, the more esteemed, being extensively used on the Continent for medicine. (2.) The West Indian, in barrels. This is always preserved in sugar, and consists of entire pods. The more perfect these are, and the more golden the colour, the more esteemed and the higher the market value, which is from twice to four times that of the East Indian product previously described. (3.) Tamarind pods, looking very much like the ripe pods on the tree, but drier and more brittle.

The stones are by no means valueless. In times of scarcity in India, after being roasted, they are soaked a few hours in water, when the dark outer skin comes off, and the residue is then boiled or fried in oil. Pulverised and boiled with thin glue the stones make one of the strongest wood cements known; while, pulverised and made into a thick paste with water, they have the property of promoting suppuration in indolent boils.

The flowers, leaves, and bark have all their uses in medicine among the natives.

Tamarind pulp mixed with salt is used among the Creoles of the Mauritius as a specific for rheumatism; and in India an infusion of the fruit mixed with sea-salt is the basis of a mixture used by the silversmiths for cleaning and brightening silver. A fine fixed yellow dye is extracted from the leaves in Bengal.

The sapwood is of a dirty-white colour, and of no value; but the heartwood, which is of small diameter, and only procurable from old trees, is very valuable and is put to many uses; being in great request for turnery purposes, for pestles, carpenters' mallets, planes, croquet mallets and balls,

and an infinity of other purposes for which its close, dark, and handsome grain fits it. Tamarind wood is considered the best fuel for the brick-kiln, burning well when green, and its charcoal is excellent for the making of gunpowder.

The tamarind is of slow growth, but is long-lived ; it attains a girth of 25 feet, but, from its spreading umbrageous habit, never any great length of trunk. Like many of its family, it is best grown from seed and sown where the tree is intended to stand ; attaining the finest proportions in a deep, rich, well-drained soil.

It is becoming common, and is very productive in Northern Queensland, where the fruit is allowed far too much to go to waste. In some few careful households, however, a certain quantity is annually preserved for domestic use ; but there is no reason why a preserve so simply and so cheaply made, and capable of being put to so many family uses, should not be plentiful in every domestic cupboard in the colony.

TAPIOCA, CASSAVA, OR BRAZILIAN ARROWROOT.

Jatropha manihot (Bitter Cassava) ; *Manihot Aip* (Sweet Cassava)—
EUPHORBIACEÆ.

The two species of Cassava are indigenous to South America, and are very generally indeed cultivated in Brazil and in the West Indies, where the several products enter largely into the food of the natives, and whence there is a considerable export of tapioca. In Brazil it bears the name of "mandioc." In appearance, when growing, the Cassava is not unlike the castor-oil plant, of which it is a near ally. The farinha, for which it is grown, is obtained from the roots, which take the form of long spindle-shaped tubers, attaining, under favourable conditions, a length of from four to five feet, and a weight as high as 30 lbs. for a single tuber.

The root of the "sweet" Cassava is not only wholly innocuous, but is sweet and wholesome to eat without any preparation, being commonly used as a vegetable boiled or roasted, and is greedily devoured by animals. It does not seem, however, to be so productive of farinha, and is not nearly so much cultivated as the "bitter" kind.

In their natural state, before preparation, the roots of *Jatropha manihot*—the bitter Cassava—are extremely poisonous ; but the poisonous principle is wholly confined to the juice, and being of a very soluble and volatile nature, is easily and thoroughly dissipated by the process of roasting, to which the ground pulp is subjected ; the faintest remnant of the poison being driven off by the drying on hot plates which the flour finally undergoes.

Dr. Barham, an able physician and a skilled naturalist, who resided in Jamaica between the years 1731 and 1740, speaking of the poisonousness of the plant, says :—" I have seen several bad accidents happen to negroes newly come to Jamaica, and strangers to the root, who have eaten of it only roasted with its juice, which has poisoned them. The symptoms are, first, a pain and sickness of the stomach, a swelling of the whole abdomen, then violent vomiting and purging, giddiness of the head, then coldness and shaking, dimness of sight, faintness, and death, all in a few hours." Dr. Patrick Browne, who practised as a physician in Jamaica about the same period, says that the poison being of a cold kind, warm and active medicines are considered the best. The Indians of Guiana give, as an antidote, a mixture of chillies mixed in rum.

Notwithstanding its deleterious character, the juice of the root is sweetish to the taste. When swallowed or when the root is eaten without preparation, it brings on convulsions, accompanied by retching and purging. It acts upon the nervous system only, producing no inflammation : but the stomach of the man or animal poisoned by it undergoes a singular contraction. Mint water, or salt of wormwood, timely administered, are said to be instant remedies, the former at least being at hand in most gardens. In order, however, to leave no doubt in the minds of my readers that by simple treatment the poisonous properties of the cassava may be wholly removed, I select from a host of authorities the following extracts, viz. :—" When it is considered that this plant belongs to a highly poisonous tribe, and is itself one of the most virulent of the species, it cannot but excite astonishment to find that it yields an abundant flour, which by the art of man becomes not wholly perfectly innocent but highly nutritious, yielding nourishment to many thousands of the natives of South America, and affording a luxury to the tables of more refined Europeans.—Rhind's Vegetable Kingdom." Again, Porter, in his " Tropical Agriculturist," says :—" The deleterious nature of the juice is corrected by subjecting it to even a moderate degree of heat, as the poisonous property is extremely volatile. After the roots—cut into small pieces—have been exposed to the action of solar heat, even for a few hours, they become perfectly innocuous, and are used as food for cattle. The juice when recently expressed from the root is immediately fatal to animals, who, after drinking it, become much swollen, and die in convulsions. But juice in the same state, boiled with meat, proves a nutritious and perfectly harmless soup, and, when seasoned, is a favourite dish of the Brazilians, called by them " casserepo."

This cassarepo, commonly known as casseripe, or cassareep, is more properly the name given to the recently extracted juice boiled into a concentrated state, of the consistence and appearance of molasses. The quality of cassareep varies a great deal, the best being made by the Indians, who have some secret of preparation. It is esteemed as a wholesome and nutritious condiment, being one of the chief luxuries among residents in the West Indies.

Cassareep is the basis of the West Indian " pepper-pot." It may be used when quite fresh, or it may be kept a considerable time ; but in the latter case it must have been boiled to a greater degree of condensation. To make " pepper-pot," a little cassareep, a good deal of water, and red pepper are boiled either with meat or fish. A little sugar or salt are sometimes added, but no vegetables are ever added before or during the boiling, though they are of course often eaten with the dish. The cassareep gives a peculiar relish to the meat, and its flavour is so strong as to entirely overpower that of the meat. The antiseptic power of cassareep is so great that the contents of the pepper-pot remain good, even in the tropics, for a considerable time. Every day the pot is reboiled; more meat, cassareep, water, and chillies being added to supply the ingredients consumed since the last boiling. A pepper-pot may thus serve as a standing dish for a long time ; and it is even said that the older West Indian colonists have been known to use and add to the same pepper-pot for thirty years or more.

The early stages of preparing cassava meal are very similar to those for the common arrowroot. The roots, having been first peeled—a process much facilitated by soaking for six hours in water—are reduced to a coarse meal by means of a grinding wheel. This breaks up into fragments the fibre, and disengages much of the fine flour. The next process varies somewhat in manipulation, but its object is to dissolve out the poisonous principle. This is done by putting the meal into a trough under pressure, and allowing water

to pass through it, or it is put into bags made of rushes, and pressed under similar conditions. With the water comes away the fine white flour, which is allowed to settle, and the water is poured off it. This flour is then put on hot plates for the purpose of drying, and by this means every poisonous taint is finally dissipated. The heat causes the starch grains to swell, while many of them burst, and the whole agglomerates into irregular masses or lumps. This process makes it difficult of solution, and cooking makes it swell up into the jelly-like masses so familiar in the puddings of our tables and sick-rooms, and with which the ideas of perfect wholesomeness, of nutrition and digestibleness, are so inseparably connected by common experience.

The chalky-white meal left in the trough or bags is fire-dried and sifted, the finest being true tapioca, the intermediate sample being used for starch and in cooking, and the coarsest being made into flat cakes and used as bread. The roots are also eaten after thorough roasting in the ashes.

The following description—taken from "Rhind's Vegetable Kingdom"—of the method of preparation in Guiana is so clear and graphic that I am tempted to reproduce it:—

"In Guiana the mode of preparation is as follows: The root is rasped on large tin or wooden graters fixed on benches, behind which the women employed in making it stand in rows. A sufficient quantity having been rasped for one time—for the surplus would ferment and spoil—it is put into long circular baskets of plaited rushes, about ten feet long and nine inches in diameter, called mangueras. These are hung up with weights attached to the lower end, which draw the plaited work tight together, diminishing its capacity, and squeezing out the juice. When all the fluid is extracted, the mangueras are emptied of their contents on raw hides laid in the sun, where the coarse flour soon dries up. It is then baked on smooth plates made of dry clay, with a slow fire below. This is the most difficult part of the process. The coarse flour is laid perfectly dry on the hot plates, where the women, with a dexterity only to be acquired by practice, spread it out in a round and very thin layer, nearly the size of the plate it is laid on. This they do merely with a piece of calabash, which they keep in constant motion, pressing gently every part of the surface, until the heat has united the meal into a cake, without in the least altering its colour or scorching it. Their method of turning a cassava cake of that size resembles sleight of hand; for they effect it with two pieces of split cane, without breaking it, though scarcely so thick as a dollar, and only as yet half cemented together, and of a substance always brittle, especially when warmed. This bread is very nourishing, and will melt to a jelly in a liquid, but it is dangerous if eaten in any quantity when dry, as it swells, on being moistened, to many times its original bulk. It will keep good for any length of time if preserved in a dry place. The expressed juice deposits, after standing for some time, a fine white starch, which, when made into jelly, is not to be distinguished from that prepared from the arrowroot."

Among the Indians of Nicaragua, and also in the interior of Peru, an intoxicating beverage is prepared by chewing the boiled root and leaving it to ferment after mixing with it hot water and cane-juice—the process and results being much the same as in the case of the "kava" (*Piper methysticum*) of Fiji and the S.S. Islands. The juice of the mandioc, extracted as described above, is also fermented with the addition of molasses, and converted into an intoxicating liquor in great favour with Indians and negroes.

The cultivation of the cassava plant is perfectly simple, and the plant has the advantage of being one of the most productive of the world—one acre yielding more nutritive matter than six times the area under wheat.

Loose, dry, sandy soils are the best; but in any case the land must be deep and well drained. A wet subsoil is highly objectionable; and if there is any doubt whatever about the condition of the drainage, the planting must be done in hills or ridges. The best cultivation is on the level in soil in all respects suitable, and two ploughings each way is sufficient preparation; or for small areas a corresponding working of the soil with the spade. In India and Brazil the cuttings, 2 to 3 feet long, are inserted upright; but in the Southern United States the cuttings are only 3 to 6 inches long, and are put horizontally at the bottom of the hole or drill and covered in out of sight. Local experience proves that two-feet cuttings 4 feet apart each way, put in on the slant like sugar-cane, and leaving from one to two eyes above the ground, suit the climate and give an abundant result. The cuttings should be taken from perfectly matured wood.

The height to which the cassava attains varies from 4 to 6 feet. It rises by a slender, woody, knotted stalk, furnished with alternate palmated leaves, which are smooth, and increase in breadth till within an inch and a-half from the top, when they diminish to an acute point. The middle lobes are 6 inches long, and 2 inches broad in the broadest part; the two next are an inch shorter, and the outer lobes are 3 inches long.

It is an exhausting crop, and care must be taken to change the soil or to let green crops and manuring intervene. A planter in Sumatra, writing to an inquiring friend in Ceylon, says, "the cassava requires any quantity of manure, and cannot be profitably cultivated without. The plant literally grows on a muck-heap; dead dogs and horses cut in pieces are often applied with advantage, besides lime, cattle manure, and bones heaped in ridges before the cuttings are planted. The crop is said to thrive better near the sea than inland. In Brazil they claim to know thirty varieties, which come to maturity in from six to twelve months after planting. Eight months may, however, be considered the period required in Queensland for the roots to mature; but they may be left in the ground after that and dug up as required. The following very excellent practical description of the best method of cultivation is given by Porter in his "Tropical Agriculturist," and as—while differing in some few particulars from the recommendations given above—it has been found to suit this climate, it is given as the verbatim testimony of an acknowledged authority:—

"It is most successfully cultivated in a free mixed soil; the crop is of so exhausting a nature that it cannot be raised more than two or three times successively on the same ground. When a plantation has yielded three crops at the most it is abandoned. This plant is propagated by cuttings. Much care is not usually bestowed on the preparation of the land previous to planting. After the ground is cleared, shallow holes are made about ten or twelve inches square and three or four inches deep; one or two cuttings of six or seven inches long are laid in each hole, which are then covered over with mould. The full-grown stem is used for these cuttings as high up as it is tough and ligneous, and well furnished with prominent hardy buds or germs. The work of planting should take place in temperate weather. A dry situation is most congenial to the growth of cassava; when cultivated on moist land small hillocks are raised on which the cuttings are set, and from which the moisture may flow, for too much humidity would cause the roots to decay and perish. In the early stage of its cultivation, however, a certain degree of moisture is requisite. The plants generally begin to shoot in about a fortnight. Care should be taken to keep the ground clean until the plants rise to a sufficient height to cover the mould and prevent the growth of all weaker weeds. In about eight months after being planted the roots are fit for use, but they may be left a considerable time in the ground un-

injured; indeed, according to some authorities, they do not attain their full growth until nearly a year beyond that time; within those periods of their age they are usually dug up as occasion requires. The cultivator endeavours to check the growth of the plant upwards by breaking off the buds; this operation is supposed to give vigour and increase the size of the root."

Manihot arrowroot or starch is occasionally adulterated by admixture with other starches, as those of sago and potato. Of twenty-three samples of tapioca examined by Dr. Hassall, two were ascertained to consist of sago and one of potato starch. It is, however, more frequently used as an adulterant, especially of Maranta arrowroot, than it is itself adulterated. The adulterations are easily detected by means of the microscope.

While our farmers are complaining of uncertain and variable markets for the very few staple articles which they produce, here is another to their hands which is easy of cultivation, simple in its method of preparation for use or sale, and an article for which there is a ready market. It will produce (says the *Scientific Farmer*, a sound American authority) more per acre than sweet potatoes, with half the labour, and must be a most valuable product if once brought into use. To a great extent it may take the place of bread here as it does for tens of thousands elsewhere, while its finer products make delicious puddings, custards, pies, and cakes. Indeed it can be worked in a host of forms, and all this apart entirely from its manufacture into the staple product of tapioca, of which the export from Brazil alone ten years ago was worth £26,000 per annum. It has the additional advantage that there is no loss of product in planting the crop, inasmuch as the stalk and not the root is used for the purpose. Recent investigations by eminent Portuguese scientists, into the properties and constituent parts of this plant, point to the probability that a future, second to few of the renowned economic plants of the world, is reserved for the *Jatropha manihot*.

TARO.

(*Caladium esculentum.*—AROIDEÆ.)

This is a tuberous plant, native of the islands of the South Pacific, where it is used largely as an article of food. In Mauritius it has long since been naturalised, where it is often found in the vicinity of running water. In some parts of China, in all the West India islands, and in parts of India, it is cultivated to a considerable extent; indeed many of the family to which the taro belongs are used in various ways for food in hot countries.

Like the cassava, the taro contains an acrid principle which makes it unfit to eat in the raw state; but this is quite dissipated by the process of cooking; and the tubers, if well cooked, either by boiling or baking, are nutritious and perfectly wholesome. The young leaves, also, when boiled, make a palatable vegetable, something like spinach.

The tuber of the taro attains the size of a child's head, when grown under wholly favourable conditions, and when boiled, or baked in hot ashes, it has a great resemblance to the sweet potato; it is however, more delicate in flavour, and probably more nutritious.

Many varieties of the taro are known, principally distinguishable by the different colour of the tubers, leaves and stalks; being of various tinges of white, yellow, and purple—some esteemed most for converting into bread, others for boiling, and others are supposed to bake best. The roots of the taro are also used in the preparation of a sort of fermented paste called *poi*, which is in much request among the islanders of the South Pacific.

The modes of preparing taro are very various. It is commonly eaten like bread, with or without salt, after having been boiled or baked. The tubers are also cut in slices and fried in lard. But the most common mode of all is to mash it, after being boiled, into a thick porridge; more water is then added, and the whole mass is allowed to ferment, which generally begins within twenty-four hours. This semi-fluid mass, referred to above as *poi*, is a favourite food of the Sandwich Islanders, who often swallow incredible quantities of it. When a pig is baked in the earth, its belly is filled with taro leaves, which are there considered an exceedingly good vegetable.

One species in Fiji reaches enormous dimensions. It grows in swamps, and often attains the height of 12 feet; the corm—or what may be styled the trunk—which is, as in the other species, the edible part, being as thick as a man's leg. A single leaf of this species will often weigh 3½ lbs., and measure 3 feet 2 inches by 2 feet 6 inches, and 13 feet 6 inches in circumference. The acrid properties of this kind of taro are, however, in excess; and, requiring greater care in the preparation, it is not as much esteemed as the smaller and commoner kinds.

The taro can be grown either in wet or dry ground. In the former case, however, the water must not be allowed to remain stagnant. If cultivated on dry ground, the same soil and treatment will suit it as is applicable to other crops grown for their tubers. Plant as the warm weather approaches, but when digging a crop the tops of the corms can be cut off and replanted at once.

The taro fields in the Sandwich Islands are generally quadrangular pieces of ground, about 50 feet square; they are dug out 2 or 3 feet deep, and are so situated that a running stream can be turned into them. These hollows generally lie like terraces one above the other, so that the water can be conveyed from the higher to the lower patches; and the borders of them, which at the same time separate the possessions of the different proprietors, are generally used as footpaths. The hollows of the taro fields are so deep that the leaves of the plants project but little above the level; the plants are set about the distance of field-cabbages from each other. In consequence of the excessive development of root, the taro plants are seldom seen in flower except sometimes in the case of old plants growing wild.

TEA.

(*Thea Chinensis, Camellia Thea.*—TERUSTRŒMACEÆ.)

Botanists are now agreed that the Tea plants of China and India are mere varieties of one species, the supposed distinctions between the species called *Thea Bohea* and *T. viridis* having been abandoned. The black and green teas are the result of different methods of preparation, and are not, as was once supposed, the products of different species; although in China the manufacture of each is in a large degree confined to separate districts. The varieties of the plant are all evergreens, varying much in point of height; the same batch of seed producing plants of different habit in that respect. The leaves are shiny and leathery, the flower white, either solitary or in clusters in the axils of the leaves.

The only well ascertained natural habitat of the tea plant is Assam, the variety found there being known as *Thea Assamica*. It is said to be also indigenous to some parts of Japan, but whether it is to be found in a natural state in China, where it is so enormously cultivated, is not yet determined

so far as I can discover. Lieutenant-Colonel Money, writing in 1870, says of the varieties of tea plants in India :—These are many, but all rise from the species which was discovered some forty years ago in Assam. The indigenous tree has a leaf 9 inches long and more ; the leaf of the China bush never exceeds 4 inches. The indigenous " flushes "—that is, produces—new tender leaf (from which only tea is manufactured) much more copiously than the China, and this is in two ways : first, the leaves are larger ; and, secondly, it flushes oftener. The infusion of tea made from indigenous species is far more " rasping " and " pungent " than what the China plant can give. A pure specimen of either is rare, and it is very difficult to rear successfully the pure indigenous. The China is much hardier when young. The plants between indigenous and China are called " hybrids ;" they were in the first instance produced by the inoculation, when near together, of the pollen of one kind into the flower of the others. Now there are very many varieties of the tea plant—a hundred or even more—and no garden is wholly indigenous or wholly China. Had China seed never been introduced into India a very different state of matters would have existed now. The cultivation would not have been so large, but far more valuable. The Indian tea is vastly superior to China, and commands a much higher price at home, but it is still very inferior to what it would have been had not China seed been so recklessly imported and distributed over the country ; it will never be possible to undo the harm then done. That the Indian plant is more prolific and fetches a higher price, is a fact which goes to show that planting from Indian seeds has a double chance over China seeds of turning out a profitable undertaking. Indian tea commands a higher price because it is so much stronger, and is therefore valuable for giving body to a mixture of China teas ; but this high price is very often out of proportion to its real value in the teapot.

The literature of the tea plant is enormous ; more probably having been written about it than upon any other plant affecting the commerce of the world, coffee and cinchona perhaps excepted. It is no easy task to compress within my available limits all the information necessary to afford a safe and sufficient guide to the pioneer of tea-growing in this country. I have therefore decided, after an exhaustive comparison of many of the best writers on the subject, to confine myself, especially upon the various phases of cultivation, to the experience of India and Ceylon. These countries have in quite modern times groped their way through all the difficulties, and their name is legion, which beset the thorough establishment of a new cultural industry ; and tea is now in both countries a staple product with a high reputation in the markets of the world, and giving promise of attaining enormous dimensions.*

As in the case of coffee and cinchona, there is great divergence of opinion among successful planters upon many points involved in the cultivation and manufacture of tea ; while the inexperienced, the unsuccessful, and the theorist each attempt to contribute their quota towards the general knowledge of the subject. Under these circumstances I have selected as my authorities—upon cultivation and manufacture—the writings of two or three practical tea-growers in different districts of India ; especially Lieutenant Colonel Money, to whom was awarded in 1870, by the Agricultural and Horticultural Society of India, a premium of three hundred rupees and the Grant Gold Medal for the best essay upon the subject, and Mr. W. R. Robertson, Superintendent of Government Farms, Madras Presidency. The Ceylon

* The export of Tea from Ceylon has increased from 282 lbs. in 1877 to 623,292 lbs in 1882. The export of Coffee has declined from 824,509 cwts. in 1878-79 to 564,846 cwts. in 1881-82.

Tropical Agriculturalist also has furnished valuable material. When I say that the material from which my notes are taken comprises an aggregate of some 500 pages of the size of the Queensland *Hansard*, dealing wholly with soil, climate, cultivation, manufacture, and markets, it will be seen how unsatisfactory to myself the result must be ; even though, as I hope to accomplish, an intelligible and useful outline of the subject may be placed before the Queensland agriculturist.

I may say that although there has for many years been a patch of tea plants in the Brisbane Botanic Gardens, no information has as yet been authoritatively placed before our agriculturists, as to the cultivation of the plant and the capabilities of our climate for the successful production of manufactured tea.

Tea, especially the China variety, will grow, although it will not necessarily flourish to the paying point, in very varied climates and soils. As a mere shrub it is hardy under the influence both of night frosts and scorching hot winds. The true climate for tea must be hot and damp : as a rule the best tea climate is not a healthy one ; but it grows with undoubted success in favoured localities at high elevations, where the climate is well adapted to the European constitution. That tea requires a temperate climate was long believed, and acted upon, by many to their loss. It is a plant which luxuriates in continual moisture ; and, that condition being present, the climate cannot be too hot for it. The value of the Indian teas consists in their strength, and as those grown under drier and more temperate conditions of climate are weaker, if more delicate in flavour, and the yield not more than half that of hot moist climates, it is obvious that the greatest amount of financial success is attainable under the latter conditions. Colonel Money is strongly of opinion that a really pleasant climate to live in cannot be a good one for tea.

The natural disposition of cultivators for their own sakes to get away from the fervid plains, together with the fact that the tea plant will more or less thrive at considerable elevations, has led to its cultivation being carried on, with varying results according to aspect and liability to frosts, to considerable heights, attaining on the Neilgherry Mountains as great an elevation as 7,500 feet. Some of the earlier planters, however, sustained serious losses, and abandoned their elevated tea gardens for other sites near the plains, or at moderate elevations with concomitant advantages of exceptional aspect and excellence of soil. Plantations in well sheltered situations are still to be found at the higher levels, but the owners have to content themselves with less certain crop, and smaller margin of profit. The higher the level at which tea is grown it may be laid down as a broad rule that the better is the China variety for the purpose. Sometimes the disadvantage of a not strictly favourable climate is counterbalanced by facilities for obtaining labour at the uncertain times when the flushes of leaves are produced ; the cost of labour being an actual drawback affecting the profits of the year, in some districts where the produce is highest. Colonel Money considers it to be a waste of means to try to cultivate tea above 4,000 feet.

The tea plant requires a light loamy friable soil, deep, and with a well-drained subsoil. These are the indispensable conditions ; but besides these qualities it cannot be too rich, responding liberally to a natural deep surface coating of decayed vegetation. Tea will not bear the least excess of water in the soil. Shallow soils and stiff soils of all kinds must be avoided ; the ends of the feeding roots of the plant being very tender and not entering readily any but a very light soil, and the taproot requiring sufficient depth for its uninterrupted development.

It is only where high cultivation is practised that tea becomes really remunerative. Manure, therefore, where the soil is not naturally rich, applied from time to time so as to prevent exhaustion, is a very essential element of success. I dwell upon this point because an idea at one time existed that manure, while increasing the yield, spoilt the flavour of the tea. Modern Indian experience has, however, shown that, so far from injuring, manure improves the flavour, while it probably adds to the strength of the leaf.

Rich animal manures, and garden refuse, decayed leaves, &c., are the best. Horse-dung requires to be heaped for some time and turned over before being applied, but cattle-dung may be used quite fresh as it is not so heating. No rubbish should be taken off the land, but everything, including the woody prunings, should be dug into the soil. It is quite unnecessary to dwell upon the modes used of applying manure. The intelligence of the Queensland agriculturist will teach him that quantity and quality available, character of soil, distance apart of the plants, and other considerations affect this point; and there is nothing in the tea plant requiring special treatment.

Reference has already been made to the superiority of the Indian tea grown from the Assam varieties. Plants of this kind have at various times been distributed in the colony, but as this has been also done with the China tea, it would be advisable, to prevent confusion and ensure a good start, for an intending planter to procure good seed from a sure source of supply in India or Ceylon. The greatest difficulty about this is not in obtaining good seed, but in its keeping without material injury to its vitality in transit. Tea seed is very perishable, and all kinds of means have been resorted to to preserve it. The best method, however, has been proved to be the following:—The fresh seed is laid in the sun for half-an-hour daily for two or three days until most of the capsules have split. The sooner it is sown after being shelled the better; but, if wanted to keep or for transport, it is packed in boxes hermetically sealed in strong loamy soil which has been thoroughly dried in the sun and passed through a fine sieve. From seed kept in this way for six months 80 per cent. of seedlings have been raised, and it must have been improperly prepared or badly packed if 50 per cent. is not raised. Boxes to hold about 20lbs. are the most convenient for carriage and less liable to breakage of the seed. In packing it is as well to put a sheet of paper at intervals to prevent the fine soil from running down together.

The seed is sown either in nurseries and transplanted, or at once in the plantation where it is intended to grow, each plan having its advocates. The nursery system has the advantage that the plants can be raised more surely by means of watering and shading; on the other hand, there is more labour in transplanting, and the plants lose three months' growth, and some of them die through the operation. In the other system the advantages and drawbacks are exactly reversed; but there is more uncertainty about the germination, which must be dependent on rain. No artificial shade can be given to aid the process, and the plantation must be kept clean six or seven months before it would be necessary by the nursery plan. For the beginner in Queensland, the nursery system is undoubtedly to be preferred; leaving it to the tea planters of the future to determine the comparative merits of the two systems, being assisted to a decision by local climatic and other conditions.

The nursery should be level, with a command of water; the soil being of the same nature exactly as that of the intended plantation, care being taken that if there be any difference in the *richness* of the soils, that of the nursery be the *poorer* of the two. Shade artificially, so that there

shall be no drip, removing the shade altogether when the plants are two or three inches high. If water be handy the seed beds are better if dug shallow, so as not to encourage a long taproot, which makes the transplanting more difficult.

The seed beds should be below rather than above the level of the paths, length immaterial, but not more than 5 feet wide to facilitate hand weeding. Seed is best sown in drills 6 inches apart and 3 inches apart in the drill. If the character of the seed is doubtful, it must be sown thicker; but it is best to test this before making a nursery on a large scale.

By not crowding the plants they can be transplanted with more care and better chance of success.

Shade the seed beds by placing forked stakes, 2 feet long, 6 inches in the paths at intervals of 5 feet. On these lay thin poles across the beds, and on these along the length of the beds split bamboos or other suitable sticks to hold the shading material. What this latter is must be left to the circumstances of each case. In India mats are used, or any coarse grass free from seed. The shade frame is then 18 inches above the beds with a free current of air underneath.

If there is no rain, water periodically as may seem necessary. Keep the soil free from weeds, and lightly stirred now and then between the growing plants. When these have, say, four leaves, the shading should be removed, but quite gradually. In shading and watering remember that the sort of plant wanted is a sturdy and hardy youngster, rather than one that is tall and weak-kneed. The difference will tell greatly in the results of transplanting.

One * *maund* of seed containing in round numbers 30,000 seeds, sown 6 inches by 3 inches, will cover, paths included, 501 square yards.

The same mistake was made in the early days of tea in India that did so much mischief among the sugar planters of Queensland: I refer to the disposition of planters to vie with each other as to who should have the largest acreage, without due regard to the means, financial and other, for keeping the land in high culture. For an individual planter 100 acres highly cultivated will pay infinitely better than 500 acres with low cultivation, and is an ample area. For a beginner a very much less area should be attempted. Recent invention is gradually elbowing charcoal out of the field for drying; but for the pioneer it provides the cheapest and simplest means, and it is of course advisable to have additional timbered land to furnish this material.

The lay of the land is a matter upon which there has been great difference of opinion. This phase of the cultivation has now settled down pretty well to the belief that considerable slopes are decidedly objectionable; and indeed that, consistently with perfect drainage and immunity from risk of flood, the land for a tea plantation cannot well be too flat. In the practice of terracing, upon which enormous sums have been spent in India, there is absolutely no virtue except to retain the soil on land too steep to do without it; but there seems to be a fashion about the practice which rises and dies away from time to time.

While the seedlings are being raised in the nurseries, the land for the permanent plantation is of course preparing; the stakes for marking the plants in their places, and the holes ready for receiving them. The holes should be at least 9 inches in diameter and 12 inches deep; the soil removed being put at the sides, and care being taken if the land is on a slope to put

* I cannot give the English equivalent of a "maund," as the weight differs in different parts of India. The weight in Col. Money's calculations is probably about 82 lbs.

the soil on the lower side. Just before planting fill up the holes with the surrounding surface soil—if this be not virgin soil or be poor, adding a very little manure to each. A fortnight or so before transplanting, the closed leaf at the head of each young plant is nipped off to make the seedlings hardier and enable them sooner to recover the transplanting. It is well to drench the seed bed before commencing, so as to better enable the operator to take up each plant with a ball of earth—a matter of the greatest importance in the degree of check which the plant receives. When all is ready the plants are lifted each with a ball and carefully laid in a basket. In the soft soil of the lately filled-up pit, a hole is made with the hand or otherwise and the seedling is put in. Care must be taken not to turn up the taproot, and that any exposed lateral roots shall preserve their natural direction. The collar of the plant when the hole is filled should be left an inch and a-half higher than the surrounding surface, and the soil should be firmly pressed down so as to minimise the subsequent sinkage. Of course, suitable weather will be selected for transplanting.

Opinions differ as to the distances apart at which the plants should be set. In good soil 4 feet is sufficient between the lines; in poor soil 4 feet 6 inches to 5 feet should be allowed. In the lines, as there is no objection to the plants touching each other, 3 feet to 3 feet 6 inches is enough; on slopes the closer the plants are together the better, as they prevent the wash of soil. For many reasons they cannot be set with too much geometrical precision; care being observed in the case of sloping land, to run the lines diagonally across the slopes.

In making a plantation there will of course be a percentage of misses, the vacancies caused by which ought to be filled up as a measure of economy of space and concentration of labour. Much has been written upon this phase of the industry. The process is attended with some difficulties upon which I have not space to dwell; but these are of a practical character which the Queensland planter will find a way to meet.

Avoid planting together seedlings of different varieties or from seed derived from more than one source; in order to avoid distinct characteristics in the plants and irregularity of appearance in the plantation, and, what is more important, want of uniformity in their power and time of producing leaves. It is not uncommon in tea plantations to see trees 3 or 4 feet high, with a spread of 9 or 10 feet in circumference, growing side by side with others of not half the proportions according as the plants are Chinese, Assam, or hybrid; but this irregularity is not wholly due to different varieties being planted together, as it may be observed often to nearly as great a degree in plants of one kind.

Young leaf being the object of production, pruning is of course an essential in the cultivation of the tea plant. This is done in the cold season immediately after the sap has gone down. The instruments used and the care taken must depend to some degree upon the extent of the plantation. There have been many theories about pruning tea plants, but, as is observed by one of the best authorities, they can have little value *practically* for the simple reason that it is impossible to prune 250,000 plants (the number in a 100-acre garden at 2,500 to the acre) with the care and system applied by a gardener to a favourite fruit tree. A common pruning knife with a good edge is the best tool when time permits. The thicker stems and branches must be cut clean, with an upward slope, just above but not too close to a bud. This theory applies equally to the slender branches and twigs, but practically it can't be done and in this case is not so material. Prune so as to cause lateral growth. A tea plant is quite high enough at 4 feet, but the wider the better. Keep a clean stem to a height of not less than 6 inches.

Plants should be more or less pruned in the centre to encourage the formation of young wood, which alone gives leaf. Plants exceeding $2\frac{1}{2}$ feet in height at the end of the season may be pruned down to 20 inches, but the thick wood must be pruned down to varying heights several inches lower. In pruning the tea plant, as between too much or too little, excess is the least evil of the two. Bury the prunings at once, as they lie between the rows, before the leaves have withered. They make the best of manure, but lose much of their virtue if left on the surface to dry.

The yield of a plantation depends upon the frequency and abundance of the "flushes," as the putting forth of a new crop of the young leaves, from which alone tea is made, is called. The number of flushes in different plantations varies enormously owing to differences of climate, soil, pruning, degree of cultivation, and manure. In elevated gardens six months is considered a fair average of the producing period, which in more favourable tea climates is extended to nine months. In the former ten to twelve, and with high cultivation fifteen, flushes may be obtained. In good tea climates, when high cultivation and liberal manuring are resorted to, as high a return as 25 flushes in the season may be obtained. To secure a reliable and certain record of the returns, careful growers divide their gardens into well marked and numbered squares, which are worked systematically.

Experience alone will teach the extent to which leaf-picking can be done, without overtaxing the constitution of the plant. The mode of procedure also, and the value of the leaves at their different ages and several positions on the shoot, must be learned by experience and study. In the mere sketch of tea-planting which space permits me to give it is impossible to explain intelligibly a phase of the subject so large as this. Anyone entering upon the enterprise, beyond the experimental stage, will of course possess himself of some of the best works upon the subject. Unfortunately much of the most reliable literature of this and other phases of economic botany are to be found only in the transactions of societies, not having been published in a separate form.

It is impossible to give any estimate of the cost, which would be of service in this country in the forming or working of tea estates. Elliott, in his "Experiences of a Planter in Mysore," says that on the Neilgherries 100 acres may be brought to full bearing for from £2,000 to £3,000, all the work being done in the most efficient style. He gives instances on well cultivated grass lands of, in the 3rd year 149 lbs., in the 4th 235 lbs., and the 5th 260 lbs. of dry tea to the acre; and is of opinion that an average of 200 lbs. per acre may be relied on. As an evidence of the hardihood of the plants, he tells of a small plantation in Mysore, partly coffee and partly Assam tea, having been abandoned because the district proved too severe for the coffee. After some years of absolute neglect the whole of the coffee trees were found to be dead, while nearly the whole of the tea shrubs were alive, and were easily restored to productiveness.

On the "Neilgherries," says Robertson, "a tea plantation of Assam or hybrid plants in a favourable situation will, under high culture, give a virgin crop at the third year of 75 to 100 lbs. of made tea per acre, and this will be equal in value to the virgin crop yielded by the coffee plantation at the same age; in the fourth year from 130 to 150 lbs.; in the fifth year from 220 to 250 lbs. In the sixth year the tea plantation will be in full bearing, when the annual yield may be estimated at 250 lbs. of made tea per acre, worth 2s. per lb. on the estate. This, on an estate of 100 acres, will represent an income of £2,500, against an expenditure, say, of £1,600, leaving a net profit of £900 per annum on the gross capital employed, say, £4,000, or a profit of $22\frac{1}{2}$ per cent. The yield may in certain years rise to 350 lbs. per

acre of made tea, while it may in a bad season fall as low as 200 lbs. The returns do not fluctuate so greatly as in the case of coffee, for this reason, that if a coffee crop is partly destroyed a whole year must pass over before another crop can be gathered, while as the tea-tree gives from fifteen to twenty flushes in the year, the loss of a single crop is of comparatively little moment. I believe that a return of 250 lbs. of made tea per acre per annum, from a well managed tea estate in full bearing, may fairly be taken as equivalent to a return of six hundredweight of clean coffee per acre from a coffee estate of the same age equally well managed, while there is more likelihood of tea continuing to command 2s. per lb. than coffee £4 per hundredweight." Tea has the further advantage that it is far less liable to the attacks of disease and insects than coffee; and under high cultivation the returns, if not so large as those occasionally obtained from coffee, are much more regular and certain, and over a term of years are quite as satisfactory. Moreover, the buildings and machinery are less expensive, and the labour more equally distributed over the year.

Injury to the tea plant from disease or insects is nowhere great, and if it arise in Queensland would probably take new form, the cure for which would have to be found by experiment. Hitherto, although tea plants have been in in the colony for many years, I have neither observed nor heard of disease or insect depredation.

The manufacture of tea is simple and inexpensive, no costly appliances being required. When we derived our ideas and knowledge upon the subject from the Chinese, it was supposed to be a long tedious process full of delicate complications, and was more or less surrounded with mystery. The successful production of tea as a staple commodity in India has exploded all that. Improved and simplified means of drying, roasting, sifting, sorting, &c., are now in use; and whether or not the Americans succeed with tea as they are endeavouring to do, the appliances for the manufacture will doubtless go on improving, even though they do not bring their talent for invention to bear on this product. The mere cultivation of the crop is no more expensive than that of any other crop, and it is in the harvesting and preparation for market alone that the labour question may present difficulties. We may fairly set aside the latter as unlikely to be hampered for the want of hands; but for the gathering of the leaf it cannot be expected that labour-saving machinery will be invented. Robertson believes that to place tea-planting on a safe and satisfactory footing, it must be combined with the practice of ordinary agriculture. The tea plant requires to be liberally manured, and the manure best suited to it is that of stall-fed cattle; while by combining farming with tea-planting the planter will be able to give constant employment to his labourers throughout the year, and to have them always at hand whenever there is a flush of leaves to gather.

I have said that not a few of the traditional stages in tea-making have been discarded. *Five* operations which occupy *two* days have taken the place of *twelve* distinct operations which occupied *three* days to produce the same result. It is necessary, however, to say that upon this point there exists some difference of opinion; and that the procedure between picking and packing is not the same among all planters, although it has been much simplified throughout India. The operations in vogue now, modified somewhat by conditions of weather and labour, are the following:—"Withering," "rolling," "fermenting," "sunning" (if sun available), and "firing." "Withering," up to a certain point, which must be learned by experience, prepares the leaf for rolling, and assists it to retain its juices. The agents for this process are sun, light, heat, and air; the sun, when available, provides them all, and in its absence a well-lighted verandah is preferable to an ordinarily lighted

room. In wet weather a room, specially constructed for a maximum of light, is provided, and heat artificially applied. The leaf is thinly spread on receptacles specially prepared, and in dry weather, after one turning, is generally ready for rolling the next morning; the time required to bring it to this condition being, of course, modified by the state of the weather and the means used.

"Rolling" is done on a smooth table free from crevices, sometimes covered with very fine matting, with a raised edging of wood to prevent the leaf falling off. Some advocate a circular motion of the hands in rolling; others one forward and backward; but the difference in result does not appear to be material, except as to time, the latter method being the quickest. Thirty pounds of leaf per man per diem is a fair amount. The men stand in a line on each side of the table, passing the roll from man to man; one of whom near the end spreads out each roll as it comes to him and picks out the coarse or red leaves.

"Fermenting" is a very important stage of the manufacture, the quality of the tea much depending upon this operation not being carried to excess. Some planters allow the balls accumulated to stand until fermented, while others place the mass of rolled tea in baskets for the purpose. The former plan seems to present most advantages. The extent to which the fermentation should be allowed to go, as in all cases of manufacture in which fermentation is a stage, can only be judged by experience. No time can be fixed for it, nor can the proper appearances be exactly described; practice alone will enable the operator to tell the exact time at which the fermentation should be stopped. When the time arrives the ball is broken up, the roll is again spread out very thin, and any remaining coarse leaves are picked out.

The roll is then *immediately* put out in the sun for the "sunning" stage, being spread *very* thinly on mats. When the upper surface turns blackish, the whole is collected together and respread. With bright sun, an hour will suffice for this process. Should the weather be cloudy the tea is still put out for such drying as it can get from light and air. In wet weather, this stage is omitted altogether; the tea being submitted to the "firing" process as soon as the fermentation is complete.

The operation indicated by the picture, so familiar to our younger days, of a Chinaman squatting in front of a thing like a washing boiler, is now carried out by improved appliances which do the work of "firing" quickly, well, and uniformly. There have been several inventions for this purpose, more or less like each other. They are very much like an iron chest of drawers, with a fire-place underneath; some constructed for burning charcoal, and others for wood and coarse grasses.

The manufactured tea, however perfect, requires sifting, sorting, and classifying to meet one of the most exacting markets in commerce. This, though done simply by means of sieves either by hand or machinery, also requires experience and judgment. The resulting outcome gives something like fourteen classes of tea, commencing at "Pekoe" and finishing off with "Dust."

"Green tea" is made from the same leaves of the same plant, but differently cured. "Flowery Pekoe" consists of the smallest and most delicate tips of the young shoots, which, as in the case of green tea, are also subjected to special treatment to bring out the peculiar flavour of this class of tea.

With this mere skeleton description of the processes of manufacture, I leave that part of the subject.

There is a vast fund of interesting information upon the general subject of this article upon which I cannot even touch; but should any of my readers desire it, I will gladly refer them to sources from which they can acquaint themselves more fully with the subject.

It is not generally known that tea is largely used as the dry base, or, in other words, as a liquid which possesses what is known as the *dry* quality, of wine, and that upon this foundation any wine can be manufactured.

Carefully-selected tea, preferably good Congou and some Oolong, is infused with boiling water in proportion of half-a-pound to the gallon. This infusion is effected in a vat with a perforated false bottom, in which the water is heated to ebullition by means of steam. When the tea is made it is drawn off the leaves (which remain in the vat on the perforated bottom), and allowed to run slowly over sugar contained in a sieve, so that every 75 lbs. of tea dissolve 25 lbs. of white sugar. To this solution a quantity of yeast (3 lbs. to 7 lbs. per 100) is added, whereupon it begins to ferment. This process must be conducted with caution, in rooms of equal temperature day and night. When partially fermented the wine is racked and fined with pure gelatine. Thereupon it begins to ferment again, owing to the removal of tannin, and now assumes character, and gradually becomes clear. In the course of a few months the beverage is ready for use.

There are several other ways of making tea-wines, and amongst them are the following:—The sugar and water are fermented by means of yeast, and a portion of the fermented liquor is infused over tea, and the strong infusion added to the fermented liquor. This process shortens the time necessary for fermentation. Such fermented liquor can also be impregnated with tincture of tea or tea-liqueur, a delicious alcoholic extract of tea. This is produced as follows:—Tea is made by means of boiling water, and evaporated to extract. This is taken up by the strongest and purest alcohol, filtered, and kept in bottles. It acquires an exquisite flavour. Of this a quantity corresponding to the half-a-pound of tea mentioned in the first-named method is put into the fermented sugar solution. The effervescent tea, or "the mousseux," is made like soda-water—namely, it is impregnated with carbonic acid after being finished.

The most extraordinary dish of tea which has come under the writer's observation is described in the following extract from the "Diary of a Hunter," by the late Colonel Irby, one of the first Englishmen who ever visited Karakorum Pass:—"Now took place a very curious and important operation—the brewing the real tea. The tea being immersed, a ladle of ghee is put in, and four or five tablespoons of salt added; then much stirring and mixing takes place, a curious implement being used to froth the beverage, like what in the Navy in my younger days—perhaps the very name now forgotten*—was called a 'swizzle-stick,' which, by rapid revolution between the hands, aerated the grog in the tumbler, giving it a pleasant sparkling appearance and freshness of flavour. The tea well mixed and frothed, and repeatedly tasted, was ladled out to the anxious party, and much relished."

* By no means, as many Mackay sugar-planters and their guests can affirm.

TURMERIC.

(*Curcuma longa.*—ZINGIBERACEÆ.)

This plant, which is indigenous to many hot countries, is in general cultivation throughout the Eastern tropics, and is in large use by the natives of the islands of the Pacific. The virtue of the plant, for all the various purposes to which its product is put, lies in the mature tubers which form the root. These vary a good deal in size as well as form, according to species, the prevailing shape being oblong; but in colour they are all more or less of a grey or greenish-yellow externally, and of an orange-yellow inside.

The uses of turmeric are manifold. In medicine, for internal use, it is regarded as a bitter, aromatic, stimulant, and tonic; and, although not much used in the present day in the pharmacopœia of civilised countries, it is commonly applied to such purposes among the natives of the countries to which it is indigenous. Among the Chinese, and in the islands of Polynesia, and in Java, it is used for intractable diseases of the skin, and in the form of ointment, or as a preservative against cutaneous diseases, and as a wash for the eyes in cases of purulent ophthalmia; while, in the form of powder, it makes an excellent application for cleansing foul ulcers. It affords a beautiful colouring matter, but, on account of its fleeting character, is less used as a dye than for the many other purposes to which it is put.

In Fiji turmeric is said by Seemann to be what rouge is to us—a cosmetic. Promoting, in the opinion of the natives, health and beauty, it is put on with no sparing hand by the women; and very pointed remarks are made of a man who is unfortunate enough to have stains of turmeric about him. With these people the preparation is like that of arrowroot, the fresh roots being grated and the fluid pressed out through fine basket-work. After some days of settlement the fluid is poured off and the sediment dried for use.

The chief use, however, probably, to which this product is put in the economy of the arts, is as a condiment and a colouring matter in culinary preparations. Its use as an ingredient of curry powder is well known, and to the presence of turmeric is probably due much of the wholesomeness of curries. Its remaining uses are in the manufacture of yellow varnishes, and, in the form of turmeric paper, as a chemical test for the presence of alkalies, which change its yellow colour to a reddish-brown. Turmeric is largely used as an adulterant of ground ginger, Turkey rhubarb, anatto, opium, liquorice, mustard, and cayenne pepper; and by the Chinese to colour certain teas. It is itself adulterated with yellow ochre, carbonate of soda, and potash.

A plaster of pure turmeric well bruised, top and roots, is reputed in the West Indies to be an antidote in snake-bite.

Five varieties of turmeric chiefly find their way to the English market—namely, China, Bengal, Madras, Malabar or Bombay, and Java; although the West Indies are now also among the producers for export. Of these the China and Bengal kinds fetch the highest prices. Two classes of root are produced from the same plant, known in trade as the "round" and "long" turmeric. The tubers are often worm-eaten.

Turmeric is produced from the old tubers of the species of curcuma under notice and its varieties; the colour and aroma which gives its character to the mature root appearing to be deposited in the cells at a late period of growth. In their young colourless state the tubers of this species, as well as the mature tubers of several other kinds of curcuma—all East Indian—furnish arrowroot; but, unlike the farina of *Canna edulis* and

Maranta arundinacea, that of the curcumas, even *C. angustifolia*, which is the chief source of "East Indian arrowroot," requires frequent washing to rid the powder of a bitter taste. The root in its fresh state has an unpleasant smell, which, however, goes off as it dries.

The cultivation of turmeric is as simple as, and much resembles that of, ginger. It likes a rich and light soil, and is planted, in the form of fragments of the root, in rows 1 foot or more apart. Others plant in beds 3 feet wide, with furrows intervening 12 to 18 inches apart, or in drills 8 inches apart. After the land is well prepared by digging, a layer of fresh vegetable or animal manure is laid on the surface, and the roots then dibbled in. When the plants are about 8 inches high they should be earthed up to keep the young formed tubers well covered, and they then require little further attention until fit for harvesting in the cold season. The tubers mature in about six months; but are fit for use, fresh, in three months or less.

An acre properly cultivated will yield about 2,000 lbs. of fresh roots. The tubers should be dug as soon as the stems fade. They are prepared for market by drying in the sun, being previously scalded to assist in destroying their vitality. I am unable to discover what is the loss of weight in the process of drying; but the prices of the dried roots in the English market vary from 12s. 6d. to 26s. per cwt. The average importation into Great Britain is about 2,000 tons annually.

It is necessary to add that while the Turmeric is indigenous to warm countries, it is cultivated in some parts of India at as high an elevation as 5,000 feet, being planted in Nepaul after wheat as a regenerating crop.

In the United States an excellent substitute for turmeric as a dye is found in *Hydrastis canadensis*, a swamp plant belonging to *Ranunculaceæ* and known as "yellow-root" or Indian dye. The colouring matter of this plant is as brilliant as that of turmeric, while it has the advantage of being more permanent.

VANILLA.

(*Vanilla aromatica; V. planifolia.*—ORCHIDACEÆ.)

This is a climbing orchid, of exceedingly handsome habit, a native of the warm regions of Central and Southern America, but flourishes in various other countries with similar climates, into which it has been introduced. Heat and moisture are essential to its vigorous growth, and shade also, provided that it be not too dense. The plant is of epiphytal habit, attaching itself to trees, but while it will grow under these conditions, it is necessary for fruitfulness that its main root should be in the soil.

The principal supply of the vanilla of commerce is derived from the two species named above, namely, *V. aromatica* and *V. planifolia*; but there are other species, differing in the size, shape, and degree of fragrance of their pods, which probably contribute to supply the markets of the world. Of these, *V. Guianensis, V. palmarum, V. pompona, V. sativa, and V. sylvestris* are the chief; the two latter being probably only varieties of *V. planifolia.* There are other species of no commercial value; of these *V. Mooreii*, peculiar to Ceylon, resembles *V. aromatica* so closely in all respects, except that the pods are not aromatic, as to be liable to deceive the casual observer. Another species, *V. Walkerii*, is almost leafless, but has beautiful white flowers, said to resemble polished silver.

Only the two subjects of this paper have been introduced into Queensland; and being the sources of the best vanilla of commerce, we need not concern ourselves with the others.

Mr. Prestoe, the Government Botanist of Trinadad, one of the most experienced of tropical cultivators of the day, speaking of *V. planifolia*, says:—"Nothing can be easier than the cultivation of this interesting and valuable plant, its few special requirements being simple and inexpensive. Much misleading matter has been written on this plant, especially as relates to its cultivation. It has been recommended to be grown on large-growing trees. It would certainly thrive, but it would not flower on a large densely-leaved tree till it had attained to light and free air in the upper branches, where it would be out of reach for artificial impregnation, gathering of the pods, and protection of the fruit from vermin. Such a tree would be even less practicable in the pollard form. In Trinidad the most perfect examples possible of vanilla growth occur on such trees as the *calabash-tree (*Crescentia cujete*), the Physic-nut (*Jatropha curcas*), and one of the coral trees (*Erythrina corallodendron*). Such trees ably support the vanilla plant, and at same time by their habit early exposing the growths to light and air, these become shortened and fruitful. The extremities—wreathed in flowers in their season—projecting beyond the larger branches of the supporting tree, hang down within reach. Such a manner of growth and support offer the most ready means for manipulating both flowers and fruit—a most important point in vanilla culture; as also for the necessary attention to the roots which remain near the surface, and require dressings of leaf-mould once or twice a year. The trees mentioned all root from stout cuttings, and, while they are attaining their growth, temporary trellises of strong bamboo can be used as intermediary supports. Special attention is required in respect of soil and dressing for the roots, as well as of occasional watering in dry weather. For Queensland, however, I doubt the trellis system. Even under the most favourable conditions of climate which we can secure, vanilla will have quite enough to contend with; and the nearer, therefore, we follow its natural habit the better.

I can speak from personal observation upon its insistence on light to enable it to flower. A plant in one of the glass-houses at Bowen Park was there for years without flowering, which it did for the first time last season, after it had been allowed to sprawl as it liked along the glass roof in the fullest exposure to the light, there being no flowers except where the plant had secured for itself that condition.

The experience of countries, in which the vanilla is an introduced plant and its successful cultivation has been the result of careful experiment, will be the best for the Queensland pioneer in this interesting product to follow; and I have therefore preferred to use for the purpose of this paper the results of such experience in India and the French West Indies.

The proper kinds of trees for this climate must necessarily be the subject of experiment. Those found to suit in India, Bourbon, and Reunion are small-growing and not too densely-foliaged trees, such as those mentioned before, and the Mango, Acacia Lebbek, the Jack-tree, the Silk Cotton-tree, etc. Probably our native Bat's-wing Coral-tree (*Erythrina vespertilio*) would also be suitable. The trees are planted close, 6 feet by 6 feet and even less, and should give shade enough before the vanilla plants are placed against them. These are in the form of cuttings with from three to five knots. If

* The only example of this tree that I know of in this part of the colony is to be seen under shelter of the residence at the Enoggera Reservoir; but as plants were at one time largely distributed, there are probably others on our northern coast. The specimen referred to flowers freely, but has never fruited.

the cutting has three knots, one is put in the ground, leaving two above; these proportions being maintained if the cuttings are longer. The cuttings are planted on the shady side of the tree, and kept firmly in their places by soft flat ties of any vegetable fibre, until the cuttings emit roots which attach themselves to the bark of the tree.

Animal manures are to be avoided, but the soil must be kept in condition by the free application of good mould or well-decomposed vegetable manure. The spring of the year, when the cold nights have permanently taken their departure, is the proper time for planting, and if the soil be dry the plants must be watered. Watering from time to time afterwards in dry weather is also essential.

The young roots are delicate and will not submit to stagnant moisture; a non-retentive subsoil is therefore an element of success.

The proper degree of shade is much that of a well-managed "bush-house"—a chequered light, consisting of as much sun as shade, with a leaning, if anything, to excess of sun. What is really required is a broken and not an excluded sunshine. This being once understood, cultivators will have no difficulty in so reducing excess of branches and foliage in the supporting trees, as to permit them to exactly fulfil this requirement.

The plants are allowed to spread from tree to tree, and where necessary, intervening supports are placed to break the force of the wind upon the festoons.

For reasons before explained the plants should be kept within reach, and with this object ambitious shoots should be brought back and trained at a proper height. In doing this any tendency of the vines to agglomerate at certain points can be remedied. In planting, however, upon a large scale, the vines are considered within reach if attainable by means of light ladders.

It is recommended to protect the leaf-mould or vegetable manure, applied to the surface of the roots, with stones, both for the purpose of keeping it in place, and keeping the roots cool and moist.

The vanilla has succeeded well in the Government Gardens at Calcutta, where many of the tropical fruits have found the climate too dry. The plants were trained to thin stone pillars seven feet high and three feet apart, with cross pieces at top, which was found a very convenient method upon the small scale required for an example, but there was not supposed to be any special virtue in stone as a support.

Ordinary cuttings may be expected under favouring conditions to produce flowers in the third year from planting.

A peculiarity in the vanilla is the rarity with which the flowers are naturally fecundated, and produce fruit. The flowers are in clusters of fifteen to twenty, and are of a greenish-white colour. The pistil of the flower is protected by a membrane which prevents the pollen from finding its way inside, unless some insect or other accidental agent happens to rupture the skin. To fertilise the flower artificially, this skin must be gently raised with an instrument (of wood or bamboo) 3 or 4 inches long, and made thin and rounded at one end. The pollen can then be introduced, or the organs brought together by a light pressure of the thumb and forefinger, and the covering then let down. The best time for the operation is between 8 and 10 in the morning. A little practice makes the work easy, but it requires care to ensure its proper performance, and to avoid injury to the organs. Only a small proportion of the whole number of flowers should be fertilised, to prevent exhaustion of the plant by causing it to bear too heavy a crop of pods.

When the pods begin to turn yellow, and before they split open, is the time to gather them; and, as the bunches do not mature together, it is necessary to go over the plants every two or three days. To gather the pod, it is held by the butt end, and is detached from the bunch by a peculiar twist.

The pods which are too much shaded are long, soft, thin, and difficult to ripen; those, on the contrary, which are sufficiently exposed to the light, are plump, firm, and better flavoured.

The preparation of the pods varies in different countries. In the Island of Reunion, they are put in a bucket and plunged for about 20 seconds in hot, *but not boiling*, water, after which they are spread on dry grass or mats to drain. They are then exposed to the sun for six or eight days, or longer, according to the weather, on tables with woollen coverings, until the pods become brown. Every evening they are placed in chests lined with woollen cloths to steam. After they have become brown and withered by this process, they are spread in the shade in an airy locality in order to dry them and prevent their getting mouldy, as well as to render them friable, although dry.

During the process of exposure to the sun, and while the pods are hot and limp, they are manipulated with the fingers in order to flatten them, and to distribute more regularly through the pod the essential oil and seed, which are in greatest abundance at the lower end. As the pods dry in the shade, which is evidenced by their becoming a chocolate colour, and by the butt end, which always dries last, showing no moisture, they are put into tin boxes, and are ultimately tied up in bundles of 50 each, care being taken that the pods in a bundle are of equal length.

After the pods have been for some time packed a brilliant white crystal efflorescence, referable to Benzoic acid, appears on the surface. In some markets this "frosted" vanilla is very much in request.

By another method the pods are prepared by piling in small heaps to ferment for two or three days, and then exposing to sun-heat. When half dry they are flattened out by the hand and rubbed over with castor, coconut, or mahogany oil, exposed once more to the sun, and then again rubbed over with oil, after which they are made up into small bundles in leaves or paper. The object of the oil is to prevent the pods from drying too fast and bursting open, and also to make them supple.

In Jamaica a process of preparation is described as having been practised at one time, but which it is to be hoped has fallen into disuse: this was to immerse the pods, before putting them in the sun, in a scalding liquor composed of three-parts strong brine and one-part chamber lye, together with a small quantity of quicklime. In Mexico, failing the sun, the artificial heat of ovens is employed; and this is probably the case elsewhere, although not so described.

The best vanilla-pods are dark, shining brown, plump, heavy, pliant, and soft, with a fine fragrant odour, the crystallised condition being preferred.

The loss of weight in drying is about one-fifth of the original weight of the pod. The crop is an exhausting one, and hence the necessity for the frequent periodical dressings of the roots with well-rotted vegetable manure or fresh leaf-mould.

It is difficult to give an average of the yield of a plant dependent so much upon the method of treatment and the skill of the grower; but there is no doubt that it is a very profitable crop to grow. Some of the statements of profit made in the French West Indies are evidently either much exaggerated or are made in error. Mr. John Horne, Director of the Botanical Gardens of Mauritius, a gentleman of very large experience in the culture of tropical products, and a cautious and reliable writer, gives the net profit per

acre in the Seychelles, upon the agriculture of which he made a special report to the Government of Mauritius, at £250 per acre. Accepting this figure as correct for that part of the world, there is a very ample margin indeed for growers elsewhere, whose early operations might be defective for want of experience and practice.

In the year 1874 a discovery was alleged to have been made by two German chemists of a substitute for vanilla in a kind of "glucose" found in the clammy secretion between the bark and the wood of certain species of the genus *Pinus*. This, when treated with certain chemical agents, the nature of which was not disclosed, was said to present the same composition as the aromatic principle of vanilla. The discovery was at the time the subject of much writing and talking, and had temporarily a discomforting effect upon vanilla-growers, and interfered with the progress of the industry. The invention, however, died a natural death, and is heard of no more. This article was sold in the form of an alcoholic tincture; and there is little doubt that much of the so-called vanilla flavouring sold in this form is pure imitation wholly wanting in the true essence. There is, however, no more necessity for the consumer to be imposed upon in vanilla than in coffee, as the vanilla-pods can be bought in bundles from the wholesale druggists; and, where the flavouring is much used, this is by far the most economical plan to adopt.

There is another plant, called in the vernacular the "herb vanilla," growing on the Swiss mountains. Its botanical name is *Nigritella angustifolia*, and it derives its common name from the fact that on hot days it emits a powerful scent similar to that of vanilla. There is, however, no extract of similar properties obtainable from it.

"The nature of the odorous principle of vanilla," says Pereira, "has not been satisfactorily made out. An odour more or less allied to that of vanilla is common to other vegetable substances." From the short life of the alleged discovery referred to above, it would appear in that case to have proved less rather than more; and that, so far as science has yet gone, vanilla as a staple product has nothing to fear.

The physiological effects of vanilla are those of an aromatic stimulant. It is considered to have an exhilarating effect on the mental functions, to prevent sleep, to increase the energy of the muscular system, and to act as an aphrodisiac. On the continent of Europe it has been used in hysteria, melancholia, impotency, and rheumatism.

THE VI—or OTAHEITE—APPLE.

(*Spondias dulcis.*—ANACARDIACEÆ.)

A native of Fiji, Otaheite, and other islands of the South Pacific, this tree is to be found attaining the height of sixty feet, with a circumference of twelve to fifteen feet. It is one of the few deciduous trees of Polynesia; but while in leaf, its pinnate light-green foliage, relieved in their season by the small white clustering flowers, and again by the rich golden hue of the oval fruit, like yellow plums, it makes a very ornamental inmate of the garden.

In Fiji the tree is found abundantly self-sown in the villages and towns, and is of frequent recurrence in the forests. It is a prolific bearer, the fruit varying much in size, but, under favourable conditions, reaching eighteen ounces in weight and twelve inches in circumference. There is a difference of opinion as to the perfume of the fruit, some authorities describing it as

the reverse of pleasant; but the tree having borne in Queensland the writer has had opportunities of judging, and decides with those who consider the fruit fragrant. The flavour is an agreeable acid, partaking both of the apple and the pineapple, while there is about the fruit a delicious fruity smell like that of the quince. It is good eating when ripe, in the raw state, but cooks capitally in pies or stewed. The natives of Fiji are very fond of it, making a very good meal off taro and vis. The stone is full of deep irregular indentations, and is covered with fibre. The fruit is perfectly wholesome, being given to the sick freely to assuage thirst.

In Jamaica, where the Vi-apple has been introduced from the Society Islands and is thoroughly acclimatised, it is considered the best of the genus *Spondias*, of which there are several indigenous representatives. It attains there a height of 20 feet, and fruits abundantly. The fruit is much more esteemed than that of any of the other species.

The wood, which is light, is used for making canoes. The Vi is cultivated from cuttings or from the stones,—which, however, do not germinate very freely,—and thrives best in good deep soil. The tree succeeds well as far south as Rockhampton at least, where it has produced abundantly, and gives high promise in Brisbane; and a specimen has fruited at Bowen Park.

WATER CHESNUT, or LING.

(*Trapa bicornis*.—HALORAGACEÆ.)

Trapa bicornis—the "ling-kok" of the Cantonese—grows in clear, still water, of a depth of one or two feet, with a soft muddy bottom. The best situations are such as are subject to a gentle overflow of river water at high tides; but it grows well in ponds, beyond the reach of high tides, where the water is prevented from becoming stagnant by the copious rains of summer, and by the active vegetable growth of the plants themselves. If left to itself it dies down on the approach of winter, reappearing upon the surface with the return of warm weather. Growing without any care or trouble, and occupying parts of the earth's surface not otherwise available for the production of food plants, are two high qualifications in its favour. The nuts, samples of which may be seen in the Queensland Museum, bear a grotesque resemblance to a bullock's head. When ripe and quite fresh, the kernel is similar in flavour and texture to a Spanish chesnut. In Canton the fruits continue in the market for four months, but towards the end of the season they get harder and drier, and are not so palatable. They are eaten by all classes of the Chinese, and also by Europeans; sometimes raw, but generally in a cooked state. For cooking they are simply boiled, and the black skin is taken off, either before or after boiling, like potatoes. On European tables they are served up with sauce. This species has been fairly tested at Bowen Park, and is evidently at home under the conditions in which it finds itself there. The statement that it requires a soft muddy bottom has been signally verified. The first nuts received were sown in two ponds; one of them with a gravelly bottom, full of springs, and the water in the other resting on mud. In the first-named the plants grew well the first year, but have gradually disappeared; while in the other they increased considerably, and but for their frequent disturbance each season would have done much better. The conditions under which they have been tried have been by no means favourable, but enough has been done to prove their adaptability to the climate.

Two other species are known, under the names respectively of *Trapa bispinosa* (the Singhara-nut), and *Trapa natans* (the Jesuits'-nut, or Walter Caltrop), both constituting important articles of food. Sir Joseph Hooker regards them as very doubtfully distinct. They are found in Europe, in India and Ceylon, and in some parts of Africa; the "Singhara-nut" being a very important product of India. As it would be an easy matter to secure its introduction into Queensland, and there is no reason to doubt its adapting itself to our climate, I take the opportunity now of describing it. The nut, like its congener the "ling," contains a large amount of fecula, but it is of greater size and produces heavier crops than that species. In Kashmir, 5,000 feet above the sea-level, miles of the lakes and marshes are covered with this plant. In the valleys it furnishes almost the only food of 30,000 people for five months of the year, and from one lake alone something like a hundred thousand ass-loads are taken annually.

The following interesting account of the Singhara-nut is given by Colonel Sleeman:—

"Here, as in most parts of India, the tank gets spoiled by the water chesnut (Singhara), which is everywhere as regularly planted and cultivated in fields, under a large surface of water, as wheat or barley is on the dry plains. It is cultivated by a class of men called Dheemurs, who are everywhere fishermen and palanquin-bearers; and they keep boats for the planting, weeding, and gathering the Singhara. The holdings or tenements of each cultivator are marked out carefully on the surface of the water by long bamboos stuck up in it; and they pay so much the acre for the portion they till. The long straws of the plants reach up to the surface of the water, upon which float their green leaves; and their pure white flowers expand beautifully among them in the latter part of the afternoon. The nut grows under the water after the flowers decay, and is of a triangular shape, and covered with a tough brown integument adhering strongly to the kernel, which is white, esculent, and of a fine cartilaginous texture. The people are very fond of these nuts, and they are carried often on bullocks' backs two or three hundred miles to market. They ripen in the latter end of the rains, or in September, and are eatable till the end of November. The rent paid for an ordinary tank by the cultivator is about one hundred rupees a year. I have known two hundred rupees to be paid for a very large one, and even three hundred, or £30 a-year. But the mud increases so rapidly from this cultivation that it soon destroys all reservoirs in which it is permitted; and where it is thought desirable to keep up the tank for the sake of the water, the cultivation of the Singhara should be carefully prohibited."

Regarding the product as one of great importance in a country like this where there are thousands of acres of land which are either constantly or periodically covered with water, and the plant being adapted, by different methods of cultivation, for both classes of area, I took steps a few years ago to obtain specially from India the most recent information about it. This was obligingly furnished by Captain Pogson, from whose letter, dated Simla, 15th December, 1879, I give the following extracts:—"The Singhara-nut, of India and Europe, bears fruit annually from the old roots, being a perennial aquatic plant. If sown in water 2 feet deep, the nuts may be gathered by going in, wading about, and collecting them in a floating vessel, say a five-gallon cask. If in deeper water, any sort of raft, float, or canoe will have to be used, and the nuts picked off. In this country several pickings take place during the season, and the last batch of nuts, *i.e.*, those that are of a large size and the kernel hard, are boiled, and so eaten. Others are shelled and dried and made into meal, while others again are buried whole, to be

used next season for seed. For example, the pool or depression, which has borne a crop of nuts, may dry up during the hot weather; when the rains commence the locality will become a pool *de novo*, and the stock of seed nuts are then dug up and sown 12 inches apart in the shallow water, putting each nut about two inches deep in the submerged soil; and this process is repeated daily as the waters rise. In due course the nuts will germinate, and yield that year's harvest. Of course, if the water did not dry up the old roots would remain alive, and in season send up a fresh crop of stems, which would in due course bear fruit. We thus see that the Singhara, if required to be turned to account as an annual crop, must be planted in localities which will become pools during the rains, and if required to become a perennial crop the nuts must be sown in the beds of shallow fresh-water pools which never dry up.

"As the Indian nut is larger and more productive than *Trapa bicornis*, I strongly recommend its exclusive cultivation. The cold of Kashmir in winter is very severe, yet it does not affect the millions of submerged roots; and as the climate of Australia is mild, the Indian Singhara will flourish there.

"It is to be understood that in no case are the nuts to be sown broadcast over the water's surface. If the water is deep, a pole of sufficient length is used to make a hole in the subaqueous soil, and by some simple contrivance a seed-nut is placed therein.

To determine whether the nuts are ripe, half-a-dozen should be picked, put in a pan with cold water and boiled for fifteen or twenty minutes, then taken out and allowed to cool. If on cutting open the nuts the kernel is found to be soft and watery, the nuts are immature; and in this state they may be eaten raw as gathered, and are very palatable. If, however, the kernel has boiled hard and mealy, the nuts are ripe and ready for harvesting. These ripe nuts will keep for some time; their kernels, when removed and sun-dried, will keep good for years. The nuts for next season's sowing are to be selected from amongst them, the largest being preferred."

Fortune thus describes the gathering of "ling" on the Taiho Lake in China:—"The water is very shallow and a great part of it is covered with *Trapa bicornis*, a plant called 'ling' by the Chinese. Women and boys were sailing about on all parts of the lake, in tubs of the same size and form as our common washing tubs, gathering the fruit of the *ling*. I don't know of any contrivance which would have answered this purpose better than these rude tubs, for they hold the fruit as well as the gatherer, and at the same time are more easily propelled through the masses of *ling* without doing the plants any injury. The sight of a number of people swimming about on the lake, each in his tub, had something very ludicrous about it."

I do not think that too much importance can be attached to the establishment, under suitable conditions, about this colony of so useful a plant. Its fruit in season would provide many a good wholesome meal to the overlander, teamster, and traveller; while to the explorer, in straits like those which beset Burke and Wills, the Singhara-nut in place of the nardoo would be an inestimable boon.

WATER-LEMON.

(*Passiflora laurifolia.*—PASSIFLORACEÆ.)

The family of the passion vine is so largely grown here; they are all so handsome, and many so useful, that it will be well to draw attention to a species which is not yet commonly known, but would be a desirable inmate of our gardens. Most of my readers who have had gardens of any size will know the following specimens, viz. :—*Passiflora edulis, alatæ, quadrangularis, Decaisneana,* and *macrocarpa.* The species under review has long been introduced, and has been largely distributed; but it partakes more than ordinarily of the shy habit of bearing of many of its congeners, and the fruit is therefore little known. It takes its name from the laurel shape of its leaves. The flower is white with red blotches, and is sweet-scented, the plant generally being very handsome.

The "water-lemon," or, as it is called in the French West Indies, "*Pomme de Liane,*" is a native of the West Indies, and is much cultivated all through South America for its fruit. This is the size of a hen's egg, but more elongated, and tapering equally at both ends. When ripe it is yellow, dotted with white spots, and contains a whitish watery pulp of a pleasing aromatic flavour, and with a delicate acid taste. It is peculiarly agreeable, and is much relished by people of all classes and colors. It is said not only to perform the usual office of cool fresh fruit, of allaying heat and quenching thirst, but the attribute of inducing appetite and elevating the spirits is also accorded to this species. The skin of the fruit is soft and thin, but tough, and the whitish watery pulp is usually got at by suction. The leaves are bitter, and are considered moderately astringent and anthelmintic, qualities shared with others of the family.

All the passion vines grow with great rapidity, and are great exhausters of the soil, which should therefore be often renovated. The flowers are produced upon the wood of the current year, and Paxton recommends that the plants should be annually pruned to one or two eyes from the old wood. The most shy of them can be made to fruit by artificial fertilisation, which is an exceedingly simple process; but it is a curious fact, stated upon high authority, which I have not yet tested, that the fruit sets better when the pollen is taken from some other species than the one being operated on. Figuier's account of the origin of the name of the genus is worth quoting: "It is derived," he says, "from a fancied resemblance to the cross, the emblem of our Saviour's crucifixion. In the five anthers the Spanish monks saw His wounds; in the triple style, the three nails by which He was fixed to the cross; and in the column on which the ovary is raised, the pillar to which He was bound; while a number of filaments which spread from the cap within the flower were finally likened to the crown of thorns."

WHAMPEE.

(*Cookia punctata.*—AURANTIACEÆ.)

This member of the orange tribe is a native of southern China, and promises to be a very useful introduction to Queensland, where it grows and fruits freely. It attains a height of about twenty feet, and for the luxuriance of the foliage alone is worth growing. Its whitish sweet-scented flowers are followed by fruit in bunches like very diminutive lemons, with a rough skin; the similarity being strongest when, at maturity, the fruit turns to a bright-

yellow. The inside consists of a delicately fragrant pulp, surrounding two or three seeds like smooth orange pips. I venture to prophesy for the whampee that it will become a favoured inmate in our gardens. I have seen it thriving along the coast from Brisbane to the Herbert River, and have known it fruit abundantly in Brisbane and Rockhampton. It likes a deep soil, but does not insist upon its being rich; and, as it comes true from seed, there are no difficulties connected with its cultivation.

THE SHADE OF TREES.

In a country like Queensland, where the days of sunshine are so much in excess of those of cloud, and the rays of the sun for many months of the year are so fierce, the subject of planting for shade purposes is one of much interest, and of no slight importance to the comfort and health of the inhabitants of all classes. It is curious enough, however, that the amount of tree-planting for this purpose which has been hitherto done is infinitesimally small, and that public interest shows little sign of turning to the subject. In the very few cases in which attempts have been made at planting shade trees, they have originated with the taste or fancy of some one member of the governing body of the locality, and have not been the result of any public demand on the part of those most concerned.

In this respect Queensland is far behind the other Australian Colonies, and I am induced, by a strong sense of the importance of the subject, and in the hope of directing public attention to it, to treat of it shortly in this series of papers, although not strictly belonging to the scope of this work.

I must except from the above observations the towns of Rockhampton, Maryborough, and Toowoomba. In the former the Municipal Council have expended large sums in planting the streets, and, encouraged by the satisfactory results of their first efforts, they contemplate considerable further operations in the same direction. The work has been carried out with judgment, and, with the exception of some mistakes in the selection of trees, the results have already proved a boon to the inhabitants, who look on with full approval at the further expenditure of the city revenues for the purpose.

In Maryborough a commencement has been made in street planting, which gives fair promise for the future.

In Toowoomba, also, several of the streets have been planted, and, upon the whole, with well-selected trees; some of those first planted already affording a grateful shade to the wayfarer. It is, however, to be regretted that the authorities have allowed themselves to be advised to remove some of the tree-guards; a course which must sooner or later lead to injury to, if not to the destruction of, trees which give full promise of fulfilling their functions. Between the horses, cattle, goats, and boys, unprotected trees in a town street stand a very poor chance of being allowed to thrive.

In the metropolis so little has been done, and that so inefficiently, that there is practically virgin ground for the efforts of some patriotic and far-seeing councillor to move his colleagues in an object of such deep concern to the ratepayers.

A little has been attempted in one or two other towns, and upon our railway lines, but without system or a knowledge of the requirements of the work; so that if here and there a tree survives to cast a grateful shade it will be rather by accident than in response to proper selection or treatment.

There is no doubt that to the narrowness of some of the streets of our towns is in some degree due the absence of planting; but as that reason does not apply to many miles of streets in which there is ample room, the real reason must be looked for, not so much in the narrowness of the streets, as in that of the minds of the selected representatives of the payers of local taxes. I very much fear that many of our Queensland aldermen regard the matter from the eminently utilitarian point of view of the Dutch councillor of an American town, who, upon being remonstrated with upon his persistent refusal to vote money for street-planting, replied, "If any pody want trees, let 'em moofe in de country—I don't want no trees in de site-walks."

It is bad enough when local bodies fail in their duty to provide the shade of trees to the hot and dusty citizen, as he plods from place to place in the prosecution of his business under the rays of a vertical sun; but what can be said of the vandalism which destroys handsome umbrageous trees the growth of half-a-century or more, for the fancied reason that they obstruct the side-walk. Surely the shade, the healthiness, and the beauty of such trees may be regarded as amply compensating for the trouble here and there of having to take a step on one side. And yet this has been repeatedly done in Brisbane by men with no more sense of the beautiful than has a carpenter's rule or a spirit-level.

Something more, but still not nearly enough, has been done in the planting with umbrageous trees town reserves and the grounds attached to churches, schools of arts, and public buildings. Such plantations—some of them most creditable—may be seen in Brisbane, Ipswich, Rockhampton, Bowen, and Townsville; and there may be others unknown to me. But much of the class of planting which has fallen under my observation has been done without sufficient judgment or skill; and little, if any, is the work of the Municipal Councils. In Brisbane, where they have attempted it, the results have been notable and melancholy failures.

Travellers in the Southern Colonies cannot fail to be struck with the immense superiority which they—especially New South Wales and Victoria—present over Queensland in this regard. In Sydney there is now hardly to be found a spot of public property which is reserved from building, or the surrounding ground of any important building of wholly or partly public character, which is not planted; the work generally showing evidences of skill, and the results being eminently grateful to the eye and pleasant for their cool shade. In Sydney the enormous disproportion of the traffic to the width of the streets make street-planting impossible; but the suburbs are beginning to wake up to its importance where space permits. In Victoria, where the towns have been designed upon a grander scale, street planting is attaining immense proportions. The city of Ballaarat, as an instance, has no less than thirty miles of streets planted with between 5,000 and 6,000 trees, the whole being the work of the municipal authorities; some of the avenues, from their length and the handsome growth of the trees composing them, already affording splendid scenic effects. The cost of planting there, including the guard, is 15s. per tree; to which must be added the cost of raising the trees, which is done in a public nursery maintained by the corporation.

Sandhurst is fast following in the footsteps of Ballaarat; and it is difficult for a visitor to realise that this pretty, cool-looking, well-planted town was once a byeword for heat, dust, and aridity of appearance. Similar work is almost universal in the towns of Victoria; and the number of pretty public gardens and well-planted and maintained reserves throughout that colony is legion.

Going further afield among English-speaking communities, we find in the United States that the creation and maintenance of plantations and the planting of streets is regarded not only as an important but an essential function of municipal bodies. So largely is tree-planting carried out in the States that in one case, and it is probably only one of many, that of "New Haven," the number and grandeur of the trees with which it has been planted has earned for it the designation of the "City of the Elms." In New York there is a Department of Public Parks, and a Board of Commissioners with the following staff:—President, Vice-President and Treasurer, Comptroller, Architect-in-chief, Engineer-in-chief, Superintendent of Squares and Places, Chief Landscape Gardener, Civil and Topographical Engineer, Superintendent of Central Park, Clerk, Assistant-Clerk, and an enormous staff of labourers, gardeners, etc. There are also adjuncts in the form of extensive nurseries and propagating houses to supply and keep up the stock of plants required; and the Board's annual reports occupy from 300 to 400 pages of printed and illustrated matter.

Brisbane of course is not New York, but we have a right to expect as much enlightenment here as there; and it is a shame to us that we do not sufficiently recognise the value of street and reserve planting, whether from an æsthetic, hygienic, or merely recreative point of view. If one wages man with the requisite skill would about represent the proportion of Brisbane to New York for carrying out these objects, he should exist as one of the municipal servants, unless we are prepared to confess being benighted and ignorant; and I am quite sure that this one man's work if properly directed would soon produce results sufficient to justify, both to the taxpayers and taxspenders, extended operations.

The principal cities of the Continent of Europe present the most perfect examples in the world of street planting. There it is the invariable practice to plant trees with the greatest care, to provide them with good soil, and to spend a great deal of money in attending to and watering them. Taking Paris as a type, we have a city with many scores of miles of trees grown to the greatest perfection of shape, the result of the greatest skill and care in raising and planting, in preparing the streets for their reception, and in tending them. Every tree is trained and pruned so as to form a symmetrical straight ascending head with a clean stem. While young, and past that when necessary, it is carefully staked, and is protected with a light iron or wooden guard. Every one of the millions of trees planted, says Robinson, is as carefully trained and protected as a pet tree in an English nobleman's park. The expense is very great, but the outlay is well repaid by the grateful shade and beauty which the trees afford.

To provide the trees there is a public nursery of the extent of nearly 50 acres entirely devoted to the raising of the commoner and more useful kinds of trees for avenue and street planting. The trees are all trained straight, and sent out as nearly as possible of equal size. The rule is to send them out with a clean stem nearly 10 feet high and about 8 feet in circumference. To bring the young trees to this condition requires systematic pruning; and it takes, in the case of the Plane, five years to arrive at the necessary size and fitness. A system of transplanting several times while young is adopted, so that when the trees are ready for ultimate removal they are lifted with a close mass of fibrous roots.

As soon as a new road or boulevard in Paris is marked out and levelled, if the soil is of bad quality, as is nearly always the case, trenches 6 feet in width by 4 to 5 feet deep are dug in the footway from one end to the other. Before filling in drain-pipes are laid along the sides, made with lapped joints, so that the roots shall not enter. The trench is then filled with good garden

soil, a little higher than the level to allow for settling. The trees are planted with perfect roots, then staked and tied with wire over a neat wad of straw. They are then copiously watered, and are protected by a neat guard neither heavy nor expensive. Besides all these precautions, over their roots are fixed iron gratings, so that the soil never cakes and the trees can always be effectively watered.

Compare the foregoing description of the most perfect system in the world with the ridiculous attempts, and their painful results, at public arboriculture made in Brisbane. Can there be worse instances of failure and ugliness than are presented by the so-called avenue of Moreton Bay chesnuts at the entrance of the Government House Domain? The tree itself, although not well suited for the position, as it is never found in a state of nature far from the banks of a creek, is capable of being trained easily with a straight stem and umbrageous head; and yet at one of the most salient point of the city we find these gnarled, crooked, ugly examples. Proceed thence to the trees on the Alice-street boundary of the Botanic Gardens for a further example of the result, after many years, of injudicious selection in the first place, and of neglect or ignorance of the requirements of trees planted for the combined purposes of ornament and shade.

All the planting about Brisbane is not, however, open to unfavourable comment, except that in some cases the planting is too close, and the trees are unable to attain their full development. Fair examples are to be seen at the Houses of Parliament, some of the churches, the Grammar School, and a few of the Government offices; but in some of these cases even it is clear that more attention would produce better results.

"No one even the most ignorant," says an American writer, "can doubt that trees add to the charms of a location. In summer time they protect it from the scorching rays of the sun, and provide pleasant and cool retreats from the heat; and in winter are of no small value in protecting our houses from the cold and piercing blasts which then prevail. Trees around a house impart a homelike and attractive appearance, and yet how few of all the houses which are built are adorned and protected by trees. The influence of homes so surrounded must be felt; and at the close of the day, when the work is done, trees present an irresistible attraction to draw families together to sit under their shade, and exercise an undoubted influence over the mind."

If this be true in a country like the United States, how much more forcibly much of it applies to a semitropical country where the sun is almost always shining. The objection which obtains in temperate climates, that trees in streets and about houses generate damp and encourage mud, does not apply here. Again, if the remarks of the enlightened American whom I have quoted are true as of streets and dwellings, how much more forcibly do they apply to the hundreds of our State Schools, which stand in the midst of arid, treeless enclosures in which the children at play are exposed to the pitiless rays of our fierce summer sun, unless they confine their games to a playshed.

The utility, the beauty, and the success of trees planted for shade purposes depends largely upon selection of species. This must depend upon the varying conditions of location, soil, area, and proximity to dwellings. The material of which the dwellings are constructed also governs the selection; as for instance, the roots of some of the *Ficus* family are apt to get into the interstices of brick and stonework and do mischief. In temperate, and especially in damp, climates there is an actual advantage in deciduous trees, which in winter do not obstruct the sun's rays when these are all wanted. Even in this climate there are conditions in which deciduous trees may be advantageous. In the more thickly populated parts of cities, the atmosphere

is often vitiated with smoke and noxious vapours, which prejudicially affect the health and appearance of evergreen trees, which instead of things of beauty become eyesores. Not so with deciduous trees. Every year they cast off their leaves, and with them the season's smoke and dirt. They have the further advantage of once a year producing fine effects when bursting into leaf or flower, the new and vigorous growth long resisting the malign influences of an unhealthy atmosphere. When these begin to be visible, the time has again arrived for the trees to discard the foliage, which is the only part injured, and putting on their winter appearance. Even in warm climates the shade is not required in winter; and the shade of deciduous trees outside houses is analogous to that of the blinds inside, which are drawn up or down as required to exclude or admit the sun, deciduous trees having the advantage of being self-acting, keeping time with our seasons.

The *list at end of this paper may be found useful; but, of course, all the trees mentioned will not be found equally suitable for all purposes alike. Of the deciduous trees, the Plane tree is perhaps the best of all, adapting itself to a very considerable range of climate. It thrives equally well where the magnolia, camellia and azalea grow luxuriantly in the open gardens of the poor, and where the frosts of winter only permit of their being cultivated in the glass houses of the rich. A most graceful as well as stately-looking tree in foliage, it retains much of these characteristics when the leaves have fallen; being wholly without the gaunt and ungainly appearance of many deciduous trees during their period of rest. To other advantages may be added that large specimens may be transplanted with safety; thus affording grand facilities for nursery training up to a point at which, when transplanted to its permanent position, you have a tree at once, instead of for the first two or three years the tree-guard being in unsightly prominence. There are two species of plane tree, of much the same character of growth. *Platanus orientalis* is a native of Southern Europe and Middle Asia. *P. occidentalis*, of North America, has a range of nearly 20 degrees from the cold of Ontario to subtropical Florida. It is the largest tree of the Atlantic forests, reaching its greatest dimensions in the rich bottom lands of the Ohio and Mississippi Rivers, where specimens occur 100 feet high and with trunks 10 to 14 feet in diameter.

For street-planting in this country what is wanted are trees with wide-spreading heads to break the force of the sun, and planted as close as possible consistently with the free action of their roots, so as to bring about the result as nearly as may be of a continuous avenue. If not wanted wholly for shade, pillar-like forms or lower growths can be used.

No exact rule can be laid down as to distance apart of the trees in avenue planting. Too close planting is a great mistake; nothing less than 25 feet apart being sufficient for ultimate growth. In Ballarat the distance is as much as much as 33 feet between the trees. If thought desirable to furnish the streets quickly, thick-growing shrubs can be planted between, which can be ultimately removed when the permanent trees have attained sufficient growth. Upon a small scale I have adopted this system with excellent results.

There is no excuse for not planting about our houses, because the means are within reach of every one, and there is no public body to set in motion. How many houses are built in this country with their fronts to the morning sun, and the rear, where all the domestic operations are carried on, exposed to the fierce midday sun, to the detriment of the health and comfort of the inmates, and to the damage of the paintwork and of many household appliances.

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* *See p. 207.*

Anyone suffering from one of these glaring back enclosures has only to contrast it with the cool comfortable look of one protected by an umbrageous tree or two, with the pleasantly subdued light resulting from their presence, and he will not hesitate at once to copy his wiser neighbour.

Apart from the importance of shade-tree planting to the comfort of the colonists, the time may come when our towns are studded with umbrageous trees, which will add a character and dignity to the streets, and show that the municipal authorities of former days were not unthoughtful for the future ; that an effect, perhaps not now contemplated, will be produced of an importance greater in some localities than even the consideration I have mentioned. I refer to the invaluable qualification in tall trees of attracting and arresting the moisture-charged clouds, so that many a grateful shower may fall in our populous cities, which, while cooling and cleansing everything they touch, shall also form a water supply ; and above all, in carrying off accumulations of fermenting rubbish, shall help to preserve the health of the towns.

The contingent advantages of street-planting to which I allude must not be considered far-fetched or remote. The effects referred to are merely a phase of the same question as that involved in the creation of forest conservancy into a State department of India.

In new countries, densely timbered, the first consideration of the settler for many years is to fell the timber ; until with lapse of time and increase of population it is found, when too late, that the rainfall is lessened, and trees have again to be planted and their growth to maturity to be watched through tedious years, until another generation comes to reap the advantage of their fathers' tardy attempt at redeeming the consequences of their shortsightedness.

It is now universally admitted that trees exercise an important influence over the climate and rainfall of a country. The precise nature and extent of that influence has yet to be determined ; but the subject is one of grave importance, still occupying the attention of some of the most eminent men of the world. We have a climate materially interested in its settlement ; and it is held by some persons, whose opinions are entitled to respect, that the influence upon certain localities, throughout the settled portions of Australia, of their denudation of trees is already making itself felt.

Intelligent observations taken in various parts of the colony, if duly recorded and compared, would probably in a few years elicit facts calculated to lead, at a period comparatively early in the history of the colony, to the avoidance of those disastrous results which ignorance of climatic laws has produced in India and elsewhere.

To the meteorological observations already taken and recorded by the Government Observer might with great advantage be added a careful record of the number of acres, with their elevation, annually denuded of their timber by settlers and others.

In a country like Queensland, capable of producing, in its various districts, almost any vegetable production on the face of the earth, especially the grand denizens of the tropics and sub-tropics, this question is endued with large proportions.

It may be averred that a lifetime would hardly produce sufficient statistics from which to draw reliable conclusions one way or the other ; but if such observations as I have suggested may, by comparison with the rainfall over a term of years, shed any light hereafter upon the subject, they are at least readily taken and would cost the colony nothing.

The amount of clearing which has been done, wherever the soil encouraged settlement, is very great, and is on the increase ; and if it is possible that our already dry climate is changing for the worse as settlement progresses, then, so far as the colony is concerned, the sooner the discovery is made the better, and a remedy applied.

Apart from our own immediate concern in the result, if by the collection of such statistics light can be thrown upon the general subject, and aid be given to the men of science who are engaged in the elucidation of this great question, the Government will have done something to benefit the human race; especially wherever our fellow-men congregate in hot climates, where toil is so much more severely felt, and the climatic causes which tend to the shortening of life are so much more numerous than in temperate regions.

More than ten years ago these views were submitted to the Administration of the day, who received them with favour; and effect would have been given to my suggestions but for the passive resistance of the then Registrar-General, who saw or thought he saw, in the willingness of the Government to adopt them, additional labour for his department.

My object in this sketch is to draw public attention to an old means of greatly mitigating in many ways the effects of a hot climate, and not to propound anything new. If that object is attained, and the example of systematic planting, whether of streets, reserves, or back yards, is once fairly set, I have no fear that it will not be followed, until that becomes the rule which is now the exception.

LIST OF SOME TREES, READILY OBTAINABLE, FOR SHADE PLANTING IN QUEENSLAND.

Albizzia Lebbek (*Sirissa-tree*).
  A. stipulata ,,
Angophora subvelutina (*Apple-tree* of Queensland).
Aleurites triloba (*Candle-nut*).
Bamboos—several species.
Calodendron Capense (*Cape Chesnut*).
Callitris (*Cypress Pine*)—several species.
Casuarina (*She-Oak*)—several species.
Cedrela Australis (*Red Cedar*).
Cupania anacardioides (*Native Tamarind*).
Castonospermum australe (*Moreton Bay Chesnut*).
Cryptocarya australis.
  C. triplinervis.
Dalbergia Sissoo (*Sissoo-tree*).
Erythrina (*Coral-tree*)—several species.
Elms—several species.
Eugenia Ventenatii (*Water-gum*).
  E. myrtifolia.
Ficus Bengalensis (*Banyan-tree*, of India).
  Benjaminea (*Weeping Fig*).
  Cunninghamii.
  glomerata (*Cluster Fig*).
  macrophylla (*Moreton Bay Fig*).
  religiosa ("*Peepul*," *Sacred Fig of India*).
  rubiginosa (*Small-leaved Moreton Bay Fig*).
  sycamorus (*Sycamore of Scripture*).

Flacourtia cataphracta (*Puneala Plum.*)
Grevilla robusta (*Silky Oak*).
Harpullia pendula (*Tulip-wood*).
Hibiscus tiliaceus.
Laurus camphora (*Camphor Laurel*).
L. B rbonica.
Melia composita (*White Cedar*).
Mulberry—several species.
Macadamia ternifolia (*Queensland Nut*).
Platanus orientalis (*Plane-tree*).
Phytolacca dioica (*Bella sombra, or Ombu*).
Pinus insignis.
Pithecolobium pruinosum.
Paulownia imperialis.
Poinciana regia.
Robinia pseudacacia (*Locust-tree*).
Schinus molle (*Peperina*, or *Peruvian Mastic*).
Spondias pleiogyna (*Burdekin Plum*).
Sophora japonica.
Sapindus—several species.
Silver Poplar.
Stillingia sebifera (*Tallow-tree*).
Tristania conferta (*Box-tree* of Brisbane District).

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